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Does Preoperative Carbohydrate Intake Reduces Postoperative Stress Response in Patients Undergoing Valve Replacement Surgeries

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Abstract

Background

Cardiac surgery is a stress that causes insulin resistance leading to increased insulin requirements. The aim of our study was to evaluate whether preoperative oral intake of carbohydrate rich drinks could improve outcomes and reduce stress response post valve replacement cardiac surgeries.

Methods

Our prospective study included 20 ASA 1-3 patients undergoing valve replacement cardiac surgeries.10 patients were fasted after midnight while the other 10 patients received 600 ml of carbohydrate bevering in the evening before the procedure and 150 ml of the drink 2 hours before operation. The following was monitored in all patients: hemodynamics after induction of anesthesia till 24 hours postoperative, insulin resistance (exogenous insulin requirement to keep blood sugar below or equal to 10 mmol/l was used as marker), postoperative discomfort using visual analogue scales, and length of ICU stay.

Results

Preoperative intake of carbohydrate rich drinks significantly reduced the length of ICU stay (p=0.019) due to reduced postoperative inotropic support requirements and time of mechanical ventilation. Significant reduction in postoperative discomfort and reduced stress response .No significant difference in postoperative level of insulin sensitivity between the two groups.

Conclusion

Our study showed that although preoperative carbohydrate intake does not reduce insulin resistance postoperatively, it significantly improved other aspects of clinical outcome, in terms of reduced ICU stay, reduced postoperative stress and patient discomfort.

Introduction

Some studies showed that it was perfectly safe to allow patients to drink clear fluids as water, coffee, tea without milk and juice until 2 hours before elective surgery. Postoperative insulin resistance (PIR) is characterizing feature of the catabolic response to surgical injury [1]. The association with stress hyperglycemia is commonly observed especially in critical illness and leads to an increase of postoperative complications [2]. Intensive insulin therapy to normalize glucose levels reduces morbidity and mortality in critically ill patients [3]. Traditional overnight preoperative fasting acts as additional metabolic stress superimposed on surgical insults and other trauma [4]. New concepts are designed to minimize stress reactions by improving nutritional status before operation [1,4]. In animal studies, rodents that were fed before stress induction showed improved muscle and cardiac function, better immunologic performance, and most prominently, better survival rates with complete recovery after hemorrhage and endotoxemia when compared with fasting subjects [4-6]. A carbohydrate (maltose and fructose)-rich, clear beverage (CHO) was developed for preoperative clinical use [1,4].

CHO elicits endogenous release of insulin, comparable to a small breakfast in halting the overnight fasting metabolic state, and can be taken up to 2 hours before elective surgery [1]. In ASA I-II patients, CHO significantly reduced preoperative discomfort, postoperative nausea

and vomiting, loss of lean body mass and muscle strength [4,7], without adverse effects [8]. Preoperative IV glucose administration and oral CHO caused significant reductions of PIR [9-11], and seemed to speed up the recovery measured by reduced length of hospital stay (LOS) [12].

Particularly in cardiopulmonary bypass (CPB)-guided cardiac surgery, the commonly associated systemic inflammatory response syndrome (SIRS) leads to marked anti-insulinergic metabolic disorders and is a major cause of PIR [13]. Whether metabolic stress response in cardiac surgery patients is reduced by CHO has not been investigated. However, preoperative IV glucose treatment has been shown to benefit cardiac surgery patients; it has been associated with reduced postoperative impairment to cardiac muscle suggested by cardiac enzyme decrease, fewer complications such as serious arrhythmias, need for vasopressor and inotropic agents, and shorter durations of ventilatory support requirements and stays in the intensive care unit (ICU) [14-17].

Therefore, the outcome measures of this prospective study were to investigate whether the preoperative oral intake of carbohydrate rich drinks in patient undergoing valve replacement surgeries attenuates PIR (peripheralinsulin resistance) as indicated by lower insulin requirements, improves postoperative discomfort reduces the stress response, dose of inotropic support used postoperatively and length of ICU stay.

Materials and Methods

This prospective study was approved by the institutional ethical committee of Ain Shams University; it was performed at Ain Shams University Hospitals between 2012 and 2013.

Our prospective study included 20 ASA II-III aged from 50-65 years old, undergoing elective valve replacement cardiac surgeries.

Written informed consent was taken from every patient. The patients were allocated into 2 groups, fasting group (10patients) including patients who were fasted after midnight; and CHO group (10 patients) including patients who received 600 mL of carbohydrate rich drink in the evening before the procedure and 150 mL of carbohydrate rich drink 2 hours before the procedure.

Exclusion criteria included conditions likely to impair gestatriontestinal motility or enhanced gestatriontestinal reflux, potentially difficult airway management, ASA physical status >IV, non-elective or emergent surgery, presence of infection, pregnancy, fructose intolerance or refusal to participate in the study.

Patients were clinically monitored in the beginning of the anesthetic procedures, preoperatively and for 24 hours after admission to the ICU.

All anesthetic procedures and CPB management were performed according to institutional standards. Patients were premedicated with diazepam (1-2 mg PO). GA was induced IV with midazolam (0.04-0.08mg/kg), fentanyl (1-4 µ/kg) and thiopental Na (3-5 mg/kg). Pancuronium (0.1 mg/kg) was given for muscle relaxation and GA was maintained with fentanyl (0.5-1 mg/h) and isoflurane (0.5-1.5 Vol%). Membrane oxygenetors Quadrox (Jostra, Hirlingen, Germany) and a centrifuged pump (Rotaflow, Jostra, Hirlingen, Germany) were used to conduct normothermic, non-pulsetile CPB.

The pump was primed by methyl prednisolone (1g), hydroxyethyl starch (500 mL HES sterile 6%) and mannitol (250 mL). All patients received 50,000 KIU/kg of aprotonin at priming. Cardiac arrest was induced and maintained by intermittent antegrade administration of warm-blood cardioplegia solution enriched with potassium. Pump flow substituted cardiac output for hemodynamic measurements during CPB. Before CPB, heparin 400 IU/Kg was given to maintain on activated clotting time (ACT) for at least 410sec. measured by hemochron Jr. ACT + (ITC, Edison, NJ).

Heparin was fully reversed with protamine after discontinuation of CPB to achieve on ACT of 100-300s.

According to standardized CPB-weaning protocol, anesthesiologists aimed to monitor normovolemia and mean arterial blood pressure of 60-70 mmHg supported by a baseline infusion of dopamine (1.5 µg, Kg^{-1}, min^{-1}) and nitroglycerin (0.1-0.5 µg, Kg^{-1}, min^{-1}). Cardiac insufficiency was assumed in cases of increasing dopamine requirements when no relevant surgical cause was identified, and was confirmed clinically by presence of a dilated and weakly contracting heart.

Transoesophageal echocardiography was performed at the discretion of the anesthiologist to confirm the diagnosis. Reduced after load was assumed when targeted mean arterial blood pressure was not reached despite normal biventricular contractility and regular filling of beating heart. In cases of cardiac insufficiency and/or reduced afterload, inotropic and vasopressor support was administered.

Inotropic treatment was prospectively defined as dopamine $\geq$5 µg.Kg-1 and epinephrine, and enoximone per se and vasopressor treatment as dopamine >10 $\mu g.Kg^{-1}.min^{-1}$ and norepinephrine per se.

Outcome Measures

Insulin requirement (primary outcome measure) was deliberately chosen as a surrogate marker to estimate PIR, assuming accurate maintenance of equivalent glucose levels among the two study groups [18].

We hypothesized that CHO group would require significantly less insulin to control blood glucose levels compared with control. Patients' serum glucose levels were monitored and documented together with the corresponding insulin dosages. Serum glucose was measured hourly by arterial blood gas analysis (Anolysctos ABL 700) Rediometer, compenhagen, Denmark). Blood gas monitors were checked for accuracy three times per day.

Adjustments of insulin dose were based on a continuous insulin infusion therapy protocol and adjusted according to hourly blood glucose measurements. We were attempting to maintain blood glucose levels between 4.4.-6.1 mmol/L, we chose a wider range of 4.4-10 mmol/L. When blood glucose level is $\geq$ 145 mg/dl, insulin infusion is initiated at a starting dose of 2 IU/hr. If blood glucose level on which insulin is started $\geq$ 181 mg/dl, the starting dose of insulin is set at 4IU/hr. If the glucose level is $\geq$ 217mg/dl, the dose amounts 6IU/hr.

Patients rated five subjective discomfort variables of hunger, thirst, mouthdryness, nausea and anxiety using visual analog scales (VAS) on the word before premedication and transport to the operating suites.

The systems used were horizontal, ungraded scales bounded by vertical lines from 0 to 100 mm, signifying the minimal and maximal extreme values of variables [7,8].

Because no pilot study had ensured that drink flavour didn't cause bias, the CHO group were asked to evaluate the taste of their drinks.

The following were monitored in all patients as heart rate and blood pressure at …, 4, 8, 12, 18, 24 hours postoperatively.

We measured both intra- and postoperative inotropic requirement in both groups.

Duration of mechanical ventilation and ICU stay was determined in the 2 study groups.

The postoperative pain which was known to affect glucose metabolism was estimated using 10 cm VAS, if score >3 morphine in boluses of 3-5mg was administered [19].

Statistical Analysis

All analysis was performed with SPSS version 20.

The minimal sample size was less than or equal 20 by type I error 5% and type II error 10% with power of test 90% by Med. Calc. 7.2.

Demographic CCC, ICU stay, intra or postoperative inotropic support, need dose insulin and VAS ratings, were compared between groups.

Using t/x^2 test and P-value $\leq$ 0.05 was considered the statistical limit variables.

Age, BMI, EF, time of mechanical ventilation and ICU stay were shown as mean ± SD.

Variables as HTN, smoking, intraoperative and postoperative inotropic support, need insulin dose and VAS ratings were shown as percentage.

MBP and HR were compared between groups using T.test and *P*-value $\leq$0.05 was considered as statistical limit. MBP and HR were shown as mean ± SD

Results

Demographic Characteristics

Demographic and clinical characteristics didn't differ among groups. There was no significant difference in insulin requirements among the study groups (as shown in Table 1).

VAS rating significantly differed between the 2 study groups with respect to hunger, anxiety and thirst (as shown in Table 2).

Table 1: Comparison of Demographic and clinical characteristics among the study groups :

		Groups		Test	
		Group I	Group II	t/X^2	P-value
Age	Range	55.000-65.000	50.000-65.000	0.371	0.715
	Mean±SD	58.700±3.368	58.100±3.843		
BMI	Range	25.000-34.000	24.000-35.000	0.073	0.943
	Mean±SD	28.400±2.914	28.300±3.199		
EF	Range	40.000-70.000	54.000-70.000	-0.206	0.839
	Mean±SD	58.100±8.062	58.700±4.448		
Sex	Female	5(50%)	4(40%)	0.202	0.653
	Male	5(50%)	6(60%)		
ASA	II	4(40%)	3(30%)	0.220	0.639
	III	6(60%)	7(70%)		
Type of DM	Type I	5(50%)	6(60%)	0.202	0.653
	Type II	5(50%)	4(40%)		
HTN		7(70%)	7(70%)	0.000	1.000
Smoking		4(40%)	5(50%)	0.202	0.653

BMI= body mass index EF= ejection fraction DM= diabetes mellitus HTN= hypertension

Table 2: comparison of time of MV , ICU stay, inotropic support, insulin dose and VAS rating among study groups:

		Groups		Test	
		Group I	Group II	t/X^2	P-value
Time of MV	Range	8.000-12.000	18.000-24.000	-13.844	**<0.001**
	Mean±SD	9.200±1.476	21.100±2.283		
ICU stay	Range	1.000-2.000	3.000-4.000	-9.000	**<0.001**
	Mean±SD	1.400±0.516	3.500±0.527		
Intropic support		8(80%)	9(90%)	0.399	0.528
Intropic ICU		4(40%)	9(90%)	5.936	0.015
Dose of Insulin given		5.5±2.01	5.8±3.70	0.225	0.824
VAS rating	Dryness of mouth	2 (10%)	6 (60%)	2.2000	0.048
	Hunger	1 (10%)	5 (50%)	6.4070	0.011
	Anxiety	1 (10%)	40 (40%)	5.0000	0.025

MV= mechanical ventilation

There was a significant decrease thirst rating between CHO and fasting groups in ICU [2 (0-7.5) mm vs 8 (09.0), P< 0.01] '"as shown in Figure 1a, 1b.

After initiation of CPB weaning until the end of operation, CHO patients required insignificantly less inotropes than did the fasting patients.

CHO patients required significantly less postoperative inotropic requirements than did the fasting patients (as shown in Table 2)

There was significant reduction in the time of mechanical ventilation of CHO group compared with fasting group (as shown in Table 2 and Figure 1).

There was significant reduction of the length of ICU stay in CHO group compared with fasting group (as shown in Table 2 and Figure 2).

There was insignificant difference in the mean arterial blood pressure between the two study groups at all time points (Table 3 and Figure 3).

There was insignificant difference in mean heart rate between the two groups at all time points (Table 4, Figure 4).

Figure 1: Comparison between the study groups as regards time of mechanical ventilation

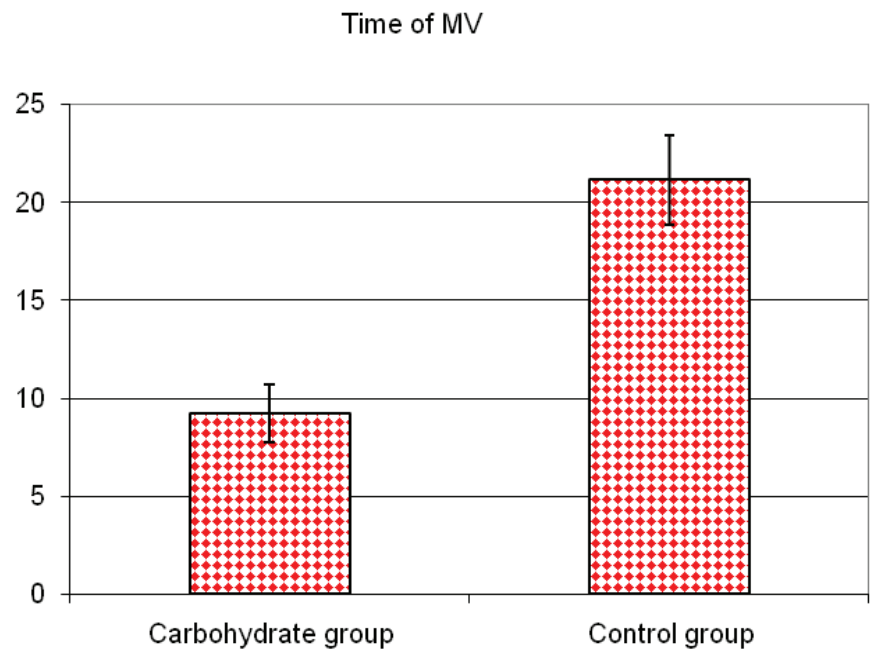

Figure 2: Comparison between the study groups as regards length of ICU stay

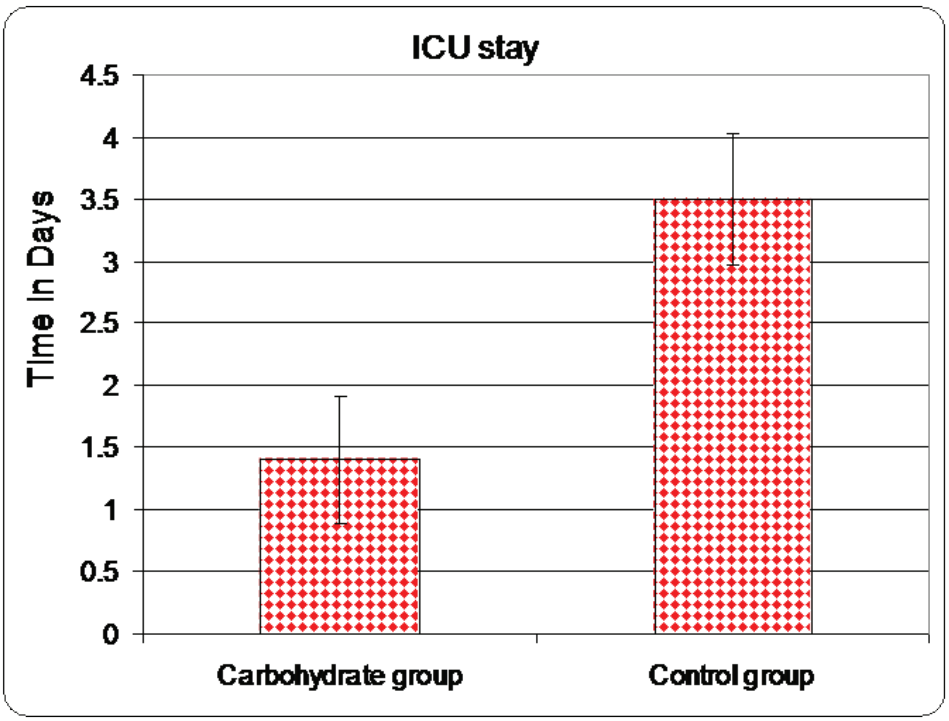

Table 3: Comparison between the 2study groups as regards the mean blood pressure.

MBP	Groups						T-Test	
	Group I			Group II				
	Mean	±	SD	Mean	±	SD	T	P-value
T 1	67.257	±	7.313	68.784	±	4.421	-0.565	0.579
T 4	67.698	±	7.669	65.660	±	4.836	0.711	0.486
T 8	66.456	±	10.056	63.207	±	9.647	0.737	0.470
T 12	64.273	±	7.192	66.029	±	5.287	-0.622	0.542
T 18	63.692	±	7.150	63.497	±	6.361	0.064	0.949
T 24	63.809	±	6.529	66.235	±	5.289	-0.913	0.373

Table 4: Comparison of the mean heart rate between the study groups:

HR	Groups						T-Test	
	Group I			Group II				
	Mean	±	SD	Mean	±	SD	t	P-value
T 1	87.900	±	4.932	91.300	±	4.498	-1.611	0.125
T 4	92.400	±	3.134	94.600	±	5.739	-1.064	0.301
T 8	88.800	±	4.984	91.400	±	4.402	-1.236	0.232
T 12	91.600	±	2.413	90.400	±	4.248	0.777	0.447
T 18	89.800	±	6.443	90.100	±	6.064	-0.107	0.916
T 24	90.000	±	3.944	87.500	±	6.654	1.022	0.320

Discussion

As insulin requirement didn't differ among our study groups, it seems that CHO administration before elective valve replacement surgery doesn't affect PIR in those patients. This contrasts with findings from previous investigations performed with ASA I-II patients which have identified significant reduction in PIR using a hyper insulinemic -euglycemic clamp technique [10,13].

We assumed that clinically relevant reduction of PIR should be identifiable by decreased insulin requirement to maintain comparable blood glucose levels.

Subjective postoperative VAS fatings revealed a reduction of thirst, hunger and anxiety in CHO group when compared with that in fasting patients.

Hausel et al. (2001) using VAS for a large sample size of ASA I-II patients undergoing abdominal surgery (n=252), also found no difference inthirst after the morning drink. However, in this study patients given CHO reported significantly decreased hunger and anxiety [8].

Henriksen et al. (2003) showed contrasting results in his study (n=48) comparing CHO administration with fasting in patients before elective bowel resection. In that study patients showed no difference even in thirst. Preoperative administration of CHO seemed to reduce intraoperative requirements for inotropic drugs [7].

A former study Quiros and Ware [17] and recently by van Hoorn et al. [5] have investigated the cardiovascular effects of prestress nutrition versus starvation in rats within hemorrhage induced hypotension and ischemic / reperfusion models, respectively. Both studies showed consistent, significantly improved cardiac function indicated by higher cardiac output and stroke volume and slower heart rates in fed versus fasted animals.

In other clinical trials, preoperative IV carbohydrate administration before cardiac surgery has also led to markedly improved cardiac performance given alone or combination with IV lipids or insulin and potassium carbohydrate was found to reduce the incidence of cardiac insufficiency and other complications i.e., fibrillation or need for vasopressors [14-17].

In particular, Lazar et al. reported reduce inotropic scores postoperatively after perioperative administration of IV glucose-insulin-potassium to patients undergoing urgent GABG surgery. However, the need for inotropic support defined as dopamine $\geq$2 μg/kg/min compared with our definition of $\geq$5 μg/kg/min did not differ significantly in their study [14].

Hatice et al. in their study showed that preparation with oral carbohydrate before spinal anesthesia had advantages overnight fasting during the perioperative period by increasing patient well being, improving insulin response but in this point it doesn't agree with our study which showed that CHO had no effect on insulin resistance [20].

A retrospective analysis of prospectively collected data showed that patients treated with preoperative CHO were discharged from hospital approximately 20% more quickly than those fasted over night suggesting that the treatment enhances recovery after surgery [12].

There is limitation of our study; include the fact that the number of patients was relatively small.

Conclusion

Our study showed that although CHO intake doesn't reduce insulin resistance postoperatively but it significantly improves other aspects of clinical outcomes in terms of reduced ICU Study, postoperative stress and patient discomfort.

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