

Assessment of factors affecting on reduction of fast blood sugar before elective surgery in children

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Original Article

Abstract

Introduction: Reduction in blood sugar and prolong the duration of fasting in infants and children's surgery have many damages. The aim of this study is to determine the affecting factors on the reduction of fasting blood sugar before an elective surgery for children.

Methods: This study is a randomized single-blind clinical trial and examining the patients that are performed on 60 children for undergoing elective surgery and the effect of age variables and duration of fasting on fasting blood sugar before induction of anesthesia was reviewed. Children were divided into seven groups based on fasting duration and were divided into four groups based on the age. Clotted blood sugar levels before induction of anesthesia and injecting of serum were examined. The information was analyzed by using descriptive statistics and t-test with SPSS software.

Results: The highest incidence of hypoglycemia (blood sugar of 59-50) was observed in children aged above 5 years (35.7%) and during the fasting hours more than 10.5 hours (40%). The impact of age and hours of fasting variables on blood sugar was statistically significant ($P > 0.0001$).

Conclusion: The causes of hypoglycemia are with increasing age, duration of fasting, likely less attention to children's clinical signs and hypoglycemia behavior, lack of adequate and proper fluids alternatives, giving lower risk and higher tolerance in older children to prolong fasting duration. It is recommended to prepare a checklist of clinical symptoms and behaviors in children and specified times before, during and after surgery shall be assessed and monitored. In addition, the fasting tolerance duration should be reviewed and new review and guide should be announced for the volume, type and duration of fluid intake before surgery in children. Obstacles to increase the waiting duration for patients' surgery must be reviewed and eliminated.

Key words: Blood Glucose, Pediatrics, Anesthesia

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Introduction:

The goals of anesthesia are Conscious perception, physiological responses, noxious stimulation,

physiological and metabolic stability in surgeries (1). For this reason, reviewing, evaluating and examining before the surgery in children who need surgery are the

major tasks for doctors, nurses, surgeons and anesthesia specialist to create the ideal conditions for the surgery and reduce postoperative complications as well (2-4).

Checking the blood fasting sugar levels and ensuring the NIL BY MOUTH (nulla per os) in children is the objective that repeatedly should be performed by all team members of nurses, surgery and anesthesia. Because, the purpose of fasting is to reduce the volume and acidity of stomach contents and reduce the dangers of Gastro esophageal reflux/aspiration. Food deprivation before the operation, and its prolonged due to the large number of patients scheduled for surgery and inappropriate programing, will cause hypoglycemia in children (4). Studies show that children due to fasting overnight and its prolonged, will easily have the thirsty feeling, dehydration and hypoglycemia (5,6).

Preoperative fasting for several hours long can activate blood sugar mutual adjustment system and the incidence of hyperglycemia. In addition, surgical stress alone can cause increased blood sugar and exacerbate hyperglycemia. Hypoglycemia and Hyperglycemia, both are dangerous for children (6).

Because the mechanism of blood sugar mutual regulation has not fully developed in infants and children than in adults and children are not able to maintain blood sugar levels within the suitable range. They are at risk in progressing towards hypoglycemia (6-10).

In addition, the anesthesia process because the patient is not awake, can hide the signs and symptoms of hypoglycemia during surgery and leave it without treatment (10). Lack of attention to the dangers of low blood sugar before, during and after surgery alone can effect on surgical outcomes (11). Moreover, it has irreparable short-term and long-term risks in any age (1,11,12). Nausea and severe vomiting after the surgery can be caused by hypoglycemia (10).

The definitive diagnosis of hypoglycemia is based on Wipfel's Triad, which consists of: Signs and symptoms of low blood sugar, low levels of plasma glucose and improving the symptoms after raising the blood sugar (13,14).

Studies have shown that the signs and symptoms of hypoglycemia between different people and even at different times in a person can be varied (15). So

far, the researchers were not able to identify the minimum blood sugar level that keeps the glucose transferring from the blood- brain barrier and take the glucose to the brain cells (8).

Although short-term and asymptomatic hypoglycemia prognosis is good and changes will disappear with hypoglycemia treatment (1), but its recur may happen quickly that given the vulnerability of the brain in the long hypoglycemia, glucose levels in plasma should be returned to normal limit quickly and should be prevented the recurrence of its attacks (11). Because the brain development during this period is very quick and lack of sufficient glucose causes severe, permanent and irreparable lesions.

Therefore, its recognition, management and treatment, especially in infants and children before and during surgery is one of the most important health care measures (1,16-18) and it seems that this issue and its significance in patients, particularly in children do not get enough attention, so the researchers have examined the affecting factors on the probability of hypoglycemia occurrence.

Methods:

Case Series method and randomized single-blind clinical trial is carried out in this study. The effect of age variables and the duration of fasting on fasting blood sugar before the induction of anesthesia were examined. The study was carried out on patients who referred to three hospitals of Khalili, Namazi and Shahid Chamran University of Medical Sciences in Shiraz, for elective surgery. The number of selected people was 60 patients that have the condition to enter the research. The entering conditions include 1. Being a candidate for elective surgery, 2. Not having inner gland and endocrine and metabolic diseases, 3. Age less than 6 years, 4. The minimum time of fasting before the surgery is 5.5 hours. Exclusion criteria of the study were the diagnosis of endocrine, metabolic diseases and the patient's exist for the fasting state. People under the study were divided into four groups in terms of age (up to the age of 6 years old) and in terms of the total fasting time until induction of anesthesia were divided into seven groups based on recording the last time to eat before surgery, according to staff and patient companions.

During the study, ethical issues were considered and relevant information to patients in the study was preserved, and no additional cost was imposed on the patient on the day of study and the patient was not injected separately for the blood sample. Before the study, the aim of this study was described for parents and older children and the blood sugar was measured with the consent of their parents.

The clotted blood sample was taken in order to determine blood sugar levels before induction of anesthesia and before starting any infusion of intravenous fluids and was sent immediately to the laboratory.

After the collecting, data were analyzed by using SPSS software. Descriptive tests and T-student test were used for statistical comparison between the age variables, and the duration of fasting and blood sugar. In this study $P < 0.00001$ was considered significant.

Results:

In this study, the age was at least 41 days and up to 6 years, its average and standard deviation were 1.68 ± 3.12 , respectively. Fasting duration before induction of anesthesia was at least 5 and up to 12 and its average and standard deviation were 1.69 ± 7.32 , respectively. The blood sugar level was at least 50 and up to 100 and its average and standard deviation were 13.8 ± 74.8 mg per dl.

According to data analysis, it was found that based on table 1 that is the relation between age and the blood sugar level; at the age of one year old, 15.4% of the patients had the blood sugar of 59-50 mg/dl and 7.7% had the blood sugar of 69-60 mg/dl and 38.5% had the blood sugar of 79-70 mg/dl and 7.7% had the blood sugar of 89-80 mg/dl and 30.7% had the blood sugar of 99-90 mg/dl, respectively. Also, generally, 21.7% of patients will be in this age group.

Between the ages of one and three years, 14.3% of the patients had the blood sugar of 59 -50 mg / dl and 9.5% had the blood sugar of 69-60 mg / dl and 52.4% had the blood sugar of 79 -70 mg / dl and 19.1% had the blood sugar of 89-80 mg / dl and 4.7% had the blood sugar of 99-90 mg / dl and 35% of the subjects are also in this age group.

Between the ages of three to five years, among the total number of patients, 26.7% had the blood sugar of 59 -50 mg/dl and 13.3% had the blood sugar of 69-60 mg/dl and 33.4% had the blood sugar of 79 -70 mg/dl and 13.3% had the blood sugar of 89-80 mg/dl and 13.3% had the blood sugar of 99-90 mg/dl and 25% of the subjects are also in this age group.

At the ages more than five years, among the total number of patients, 45.4% had the blood sugar of 59 -50 mg/dl and 9.1% had the blood sugar of 69-60 mg/dl and 9.1% had the blood sugar of 79-70 mg/dl and 27.3% had the blood sugar of 89-80 mg/dl and 9.1% had the blood sugar of 99-90 mg/dl and 25% of the subjects are also in this age group.

It should be noted that in total, 66.7% of children had normal blood sugar levels and were in the range of 70 -100 mg/dl, 10% were between 60-70 mg/dl and 23.23% were less than 60 mg/dl respectively.

According to table 2 that shows the relation between blood sugar levels and the fasting time, it became clear that due to the fasting time up to 5.5 hours, 37.5% of patients had the blood sugar of 59 -50 mg/dl and 12.5% had the blood sugar of 69-60 mg/dl and 25% had the blood sugar of 79-70 mg/dl and 12.5% had the blood sugar of 89-80 mg/dl and 12.5% had the blood sugar of 99-90 mg/dl and 13.2% of the subjects are also in this interval.

With regard to the period of fasting; 25% of the study cases remained 5.5 to 4.6 hours, 20% of study cases remained 6.5 to 7.4 hours and 16.4% of participants remained 7.5 to 8.4 hours, and 10% of subjects remained 8.5 to 9.4 hours, 6.6% of subjects remained 8.5 to 10.4 hours and 8.3% of the subjects remained about 10.5 hours and more fasting till the induction of anesthesia.

On the other hand, according to Table 2 which corresponds to the relation between blood sugar and the time of fasting, 23.3% of patients had the blood sugar of 59 -50 mg/dl and 10% had the blood sugar of 69-60 mg/dl and 36.7% had the blood sugar of 79 -70 mg/dl and 16.7% had the blood sugar of 89-80 mg/dl and 13.3% had the blood sugar of 99-90 mg/dl.

Table 1. The relation between the age and blood sugar levels and their frequency in percent

Blood sugar Age	50-59	60-69	70-79	80-89	90-99	More than 100	The number and frequency (%)
Less than 1 year	2 (15.4%)	1 (7.7%)	5 (38.5%)	1 (7.7%)	4 (30.7%)	-	13 (21.7%)
1 to 3 years	3 (14.3%)	2 (9.5%)	11 (52.4%)	4 (19.1%)	1 (4.7%)	-	21 (35%)
3 to 5 years	4 (26.7%)	2 (13.3%)	5 (33.4%)	2 (13.3%)	2 (13.3%)	-	15 (25%)
More than 5 years	5 (45.4%)	1 (9.1%)	1 (9.1%)	3 (27.3%)	1 (9.1%)	-	11 (18.3%)
Total and percentage	14 (23.3%)	6 (10%)	22 (36.7%)	10 (16.7%)	8 (13.3%)	-	60 (100%)

Table 2. The relation between different fasting times and blood sugar levels and their frequency in percent

Blood sugar Fasting time	50-59	60-69	70-79	80-89	90-99	More than 100	The number and frequency (%)
Up to 5.5 hours	3 (37.5%)	1 (12.5%)	2 (25%)	1 (12.5%)	1 (12.5%)	-	8 (13.3%)
6.4 to 5.5 hours	2 (13.3%)	2 (13.3%)	5 (33.4%)	4 (26.7%)	2 (13.33%)	-	15 (25%)
6.5 to 4.7 hours	2 (16.7%)	1 (8.3%)	4 (33.3%)	3 (25%)	2 (16.7%)	-	12 (20%)
7.5 to 8.4 hours	2 (20%)	-	8 (80%)	-	-	-	10 (16.4%)
8.5 to 9.4 hours	2 (33.4%)	1 (16.7%)	1 (16.7%)	1 (16.7%)	1 (16.7%)	-	10%
9.5 to 10.4 hours	1 (25%)	-	1 (25%)	1 (25%)	1 (25%)	-	4 (6.6%)
More than 10.5 hours	2 (40%)	1 (20%)	1 (20%)	-	1 (20%)	-	5 (8.3%)
Total	14 (23.3%)	6 (10%)	22 (36.7%)	10 (16.7%)	8 (13.3%)	-	100

Conclusion:

According to statistical findings, Table 1, and 2 and according to the concept of hypoglycemia and its definition that was presented, in this study, although, no child had the blood sugar level less than 50 mg/dl and no cases of hypoglycemia were reported during surgery, but, it should be noted that (14 children) 23.3% of the cases had the blood sugar levels less than mg/dl 60 at the time of anesthesia induction. This result is consistent with the review of several reported studies in a structured review article in the UK that was done by Jones and Mackinnon on the issue of hypoglycemia in children without metabolic problems, before induction of anesthesia and given a period of fasting. The results showed that the statistical tests presented no relation between the type of surgery and duration of fasting and hypoglycemia risk and hypoglycemia incidence before induction of

anesthesia and according to the duration of fasting was low (6). Although scientifically, the clinical diagnosis of hypoglycemia with blood sugar less than 60 mg/dl is difficult in patients undergoing surgery, in this study, 23.3% of all children had hypoglycemia in all periods of fasting and the higher age of children, the higher probability of hypoglycemia will be. This result is contrary to the findings reported in the paper of Jones and Mackinnon that shows hypoglycemia is associated with age and weight and the youngest and smallest children are more likely to develop hypoglycemia (6).

According to the researchers' experiences, the causes of this problem in our study, for patients undergoing elective surgery that are hospitalized the night before or the morning of surgery, include no standard protocol for prescribing oral fluids as long as it does not increase the risk of aspiration, delay at the onset intravenous fluids at the time of

venipuncture and before induction of anesthesia or inappropriate, inadequate and infrequent intravenous fluid replacement from the night before the surgery and during the patients' fasting time. Alorus1 in his research suggested that it could be possible to give patients undergoing elective surgery, solid foods up to 6 hours and clear liquids up to 2 hours before surgery without increasing the risk of aspiration and hypoglycemia (11). Murat et al suggested in their research the use of ISO tonic solution with dextrose 10% in infants (18).

However, in various studies for supplying energy and maintaining basic metabolic, they have suggested hemodynamic status of the body, all kinds of liquids, different volume and distance at the time of fasting and during surgery to reduce the mortality and morbidity associated with surgery (5,6,19,20).

However, in this regard Janet Makan et al in 2014 showed in Ahvaz that intake of fluids containing dextrose in order to fluid therapy during anesthesia for elective surgeries are unnecessary and only monitoring blood sugar levels during long-term surgeries to prevent the hypoglycemia in the patient and its complications is sufficient (21).

While in this study, there was a comparison between age and hours of fasting with blood sugar, but its relation to weight and hours of the day, has not been done yet. That should also be considered in future studies on this variable, because studies have shown that maybe, in skinny children, no relation will be observed between low blood sugar and symptoms of hypoglycemia. On the other hand, in children with 20 milligrams per deciliter of blood sugar compared to children with higher blood sugar, fewer symptoms of hypoglycemia will be seen. However, a significant relation is seen between the falling pace of blood sugar and the severity of symptoms (5). Binder et al suggested that blood loss is common, particularly at night and is often asymptomatic (biochemical hypoglycemia). The most common time of low blood sugar is during the day at 9-12 and especially before lunch (6).

In our study, that their blood glucose was less than mg 60, they were more than 5 years of age, it can be concluded that in younger children, due to falling blood sugar levels and the risk of hypoglycemia and its complications in this age

group, they allowed parents to give their children milk or fruit juice at least 4 to 5 hours before the surgery.

In Table 2 it is observed that in the group up to 5.5 hours, most people are between 3 to 5 years and in fasting time group up to 5.5 to 6.4 hours, most people are between 3-1 years and in other groups, the frequency was almost the same. Although most children in this interval had normal or near-normal blood sugar, but in the group between 9.4 to 8.5 hours and in a group more than 10.5 hours, the blood glucose and hypoglycemia fall have been seen that maybe its reason is not allowed for older children and their parents for fluid intake (due to the expectation of more tolerance this age group, even with prolonged fasting time), or the number of samples was low or the laboratory report errors.

According to the results, it is essential that the surgery type, weight, time of day, volume, type, time of intake materials before the surgery, post-operative complications and the patient's condition improved after surgery in relation to the amount of blood sugar and fasting period will be examined.

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