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Evaluation of the effect of general anesthesia for dental work on learning ability in 7-10 years old children

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ABSTRACT

Introduction

General anesthesia is used to control uncooperative children in dentistry; the impact of anesthesia on child learning is a concern. The frequency of anesthesia and the duration of it may influence the child's learning process. This study was conducted to investigate the effect of general anesthesia on children's learning.

Method and materials:

In this prospective clinical trial study, 36 healthy children aged 7 to 10 years who were candidates for dental work under general anesthesia were selected by simple sampling.

Before anesthesia and one week later, learning impairment score evaluated with LDES-R2 learning impairment assessment questionnaire, and the results were analyzed using paired t-test, Pearson correlation and independent t-test in SPSS 20 software.

Results:

The maximum score of learning disorder with LDES-R2 questionnaire is 246.

The mean score of learning disorder before anesthesia was 26.6 and the mean score one week after that was 38.1. Paired t-test showed a significant increase by 5% in learning impairment score ($P < 0.05$).

Discussion:

Previous studies have shown disagreement about the effect of general anesthesia on learning ability, the number of anesthetic visits seems to be more important.

In this study, general anesthesia for dental work resulted in a 5% increase in the mean score of learning disabilities in children, since our assessment was performed one week after anesthesia and may still have anesthesia memory effects, which may be longer since anesthesia, the average score may be dropped below 5%.

Keywords

General anesthesia, Dentistry, Learning ability

Introduction

Because lack of cooperation of children during dental treatments. Various methods are used to control a child in a dentistry environment (1,2). General anesthesia, as a controlling method in children, is used when the child does not show the required coordination during the dentistry work (3-5).

General anesthesia has respiratory, heart and cerebral complications. Although the incidence of these complications is low, one of the concerns of the parents and the treatment team is medical complications during and after anesthesia. One of the complications which might occur after anesthesia is learning disability (6-8).

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Learning disability is an unexpected disease, developing in a child with moderate or high intelligence. It is characterized with significant lag in one or more learning domains. Learning disabilities refer to a series of child problems in domains of reading, writing, speaking, spelling, comprehension, and mathematics. Learning disabilities are usually diagnosed when the child goes to school (often after the age of 8) (9-13).

One of learning disability evaluation method is "Learning Disability Evaluation Scale-Reformed second edition" (LDES-R2). It is a standardized questionnaire based on the evaluation of thinking, listening, speaking, reading, writing, spelling, and mathematical computing in 6-18 years of old students. In addition, gender, living place, race, geographical location, and parental job will be influential in this study (14).

Wilder et al (2009) conducted a study entitled "general anesthesia and learning disabilities". They found that children who received anesthesia twice or more had a high risk of learning disabilities. This risk increases with increasing the anesthesia duration (15).

Moreover, Kalkman et al (2009) conducted a study entitled "development and behavior in children and the age at the time of the first exposure to anesthesia", and they concluded that the children, who aged less than 24 months when exposed to general anesthesia, experienced more behavioral disturbances (16). In another study conducted by Bong et al in 2013 under the title of the effects of general anesthesia in the early stages of life on academic performance, it was revealed that the odds of diagnosing the learning disabilities in these children was 4.5 times higher than that of their peers who had never received anesthesia (17). Steinmetz et al (2011) conducted a study under the title of anesthesia and post-operative cognitive impairment and concluded that there was no relationship between the depth of anesthesia and cognitive impairment after one week (18). As there is controversy on the effects of anesthesia on memory and due to the lack of studies in this area and the importance of examining the memory and learning disabilities in children, this research was conducted to evaluate the relationship between anesthesia and learning disability in children underwent dentistry anesthesia.

Methodology In this prospective clinical trial, a total of 36 healthy children aged 7 to 10 years undergoing general anesthesia of dentistry were studied. They were selected using convenient sampling method. The research tool included Learning Disability Evaluation Scale-Reformed second edition (LDES-R2). It included several sections. Each question has a minimum score of 0 (means lack of learning disability) and a maximum score of 3 (means severe learning disability).

Research inclusion criteria included children aged 7 to 10, having complete health, lack of recognized mood and behavioral disorders, and candidate for general anesthesia for dentistry. Exclusion criteria also included causing medical problem during and after dentistry work and the lack of cooperation between parents and the child in completing the questionnaire. Preoperative evaluation and preoperative fasting were explained to all in similar way.

After initial evaluation, the child was entered into study by consent of his or her parents if met the inclusion criteria. Then, learning disability evaluation scale was completed with interviewing with child. The patient was given a work shift and an anesthetic induction was performed using thiopental sodium, fentanyl and atracurium in the working day.

Anesthesia was maintained with oxygen, 50% Nitrous Oxide and isoflurane. The time of anesthesia and dentistry works were recorded. After the completion of the dentistry work, the anesthetic drugs were discontinued and the child was transferred to a recovery and underwent standard care. When he or she met the discharge criteria based on Post Anesthesia Discharge Scoring System (PADS), he or she was discharged (19).

After a week, the child was recalled for re-evaluation, and the LDES-R2 form was re-completed in an interview with the parents. Interview and completion of questionnaire for all subjects was performed by a trained nurse. The results were analyzed using Paired t-test, Pearson correlation and independent t-test in SPSS-20 software.

Result

In this study, 36 children with mean age of 8 years, (17 of them were male and 19 of them were female) were studied.

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The mean of learning disability in listening area, before anesthesia was 0.75 and it was 1.17 one week after anesthesia. T-paired test showed that the difference in this score increased significantly ($p<0.05$). (Table: 1).

The mean score of learning disability was 0.78 in the thinking domain before the anesthesia and it was 2.78 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). (Table: 1).

The mean score of learning disability was one in the speaking before anesthesia and it was 1.97 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). (Table: 1).

In the writing domain before the anesthesia was 3.9 and it was 6.5 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). Table (2-4).

The mean score of learning disability was 5.5 in the spelling domain before the anesthesia and it was 7.1 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). (Table: 1).

The mean score of learning disability was 11.4 in the mathematics domain before the anesthesia and it was 15.2 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). (Table: 1).

The mean score of learning disability was 3.22 in the reading domain before the anesthesia and it was 3.5 one week after anesthesia. Based on the t-paired test, the difference in this score did not increase significantly ($P <0.05$). (Table: 1).

The mean total score of learning disability was 26.6 before the anesthesia and it was 38.1 one week after anesthesia. Based on the t-paired test, the difference in this score increased significantly ($P <0.05$). (Table: 1).

Table 1: Mean score of learning disability before and after anesthesia

Variable	Before	After	P-value
listening	0.75	1.17	0<0.05
Thinking	0.78	2.78	0<0.05
Speaking	1	1.97	0<0.05
Reading	3.22	3.5	0<0.05
Spelling	5.5	7.1	0<0.05
Writing	3.9	6.5	0<0.05
Mathematics	11.4	15.2	0<0.05
Total Score	26.6	38.1	0<0.05

Pearson correlation coefficient showed that learning disability has a reverse and significant relationship with age in domains of thinking, speaking, reading, writing, spelling, and mathematics ($P>0.05$). (Table: 1).

The mean time of anesthesia in this study was 5.72 minutes and the mean recovery time was 67.1 minutes. The Pearson correlation coefficient showed that the increase in learning disability one week after surgery, compared to before surgery, had a direct and significant relationship with the duration of anesthesia and recovery in all domains of learning ($P < 0.05$) (Table: 1).

Discussion

The effect of anesthesia on learning disability is still unknown. Its percentage is … . Factors such as age, heavy dentistry work, long duration of anesthesia, and long recovery time can increase it. Not only anesthesia, but also environmental conditions can also be involved in increasing the score of learning disability (6). As this investigation was performed one week after anesthesia, the effect of the anesthesia memories has remained still for the child, leading to an increase in learning disability score. It is clear that the term "learning disabilities" is a set of specific disabilities.

Children may have problems in different domains of learning. Some of the disabilities occur simultaneously in children. For example, spelling problems are often associated with reading problems and mathematics problems are often associated with language problems. However, any combination of these disabilities can occur (14).

The results of human studies are rare and most of them are based on the history of exposure to anesthesia in the early years of life, which show conflicting results. Other factors complicate the anesthetic risk evaluation on brain development include non-standard anesthetic protocols with different types of anesthetic agents, dosage and exposure time, different types of surgical stress and different patient conditions (20). The mean total score of learning disability was 6.26 out of 264 before surgery and it was 1.38 out of 264 one week after surgery.

While the difference was significant, the dentistry work under anesthesia only increased the mean score of learning disability by 5% and since our evaluation is performed one week after anesthesia and the effect of the anesthetic memory still remains, the score might be less than even 5% with longer time intervals of anesthesia. In 2009, Bartles et al evaluated 1143 monozygotic twins who had received anesthesia before the age of 3 and between the ages of 3 and 12, age 12, by means of standard tests and teachers' academic achievement ranking.

The result showed no causal relationship between the anesthesia and the subsequent learning disabilities, and this study is inconsistent with the current study. It may be due to the fact that the evaluation in this study was performed with more time interval with anesthesia time (21). However, in this study, one week after the operation, the learning abilities were evaluated while the effect of anesthesia on short-term memory has remained.

In 2012, Yang et al investigated the learning abilities in 21 children aged 5 to 10 years before strabismus surgery under general anesthesia with sevoflurane and after 4 weeks. Results showed that general anesthesia does not affect the cortical learning abilities of these children, and this study is inconsistent with the current study.

It may be attributed to the use of sevoflurane in this study (20). However, in the current research, children were anesthetized by isoflurane and the evaluation was performed 4 weeks after anesthesia, in which the effect of anesthesia memory has been lost. In 2014, Wang et al conducted a study on common clinical evidence of the effects of general anesthesia on neurodevelopment in children.

The results showed that the frequency of anesthesia is more important than an exposure to anesthesia before the age of 4 and the hazard ratio of this relationship is 1.25. Anesthesia has a relatively high risk of neurodegenerative development, and this study is consistent with the current study (22). There is no study to evaluate the relationship between gender variable and learning disability after anesthesia.

This relationship was examined for the first time in this study. The only similar study that studied one animal sample on male and female rats by Beslow et al, showed that female rats are more vulnerable than male rats (23). Prospectively, the current study cannot determine whether the gender is involved in this regard or not and further investigations are required.

There is also no study consistent with this study, which examines the relationship between recovery time and the post-anesthetic learning disability score. This relationship was examined for the first time in this study.

Conclusion: The investigation conducted before and after anesthesia in children aged 7 to 10 years, the increase in learning disability score one week after anesthesia, shows that this increase in learning disability has a significant relationship with age, gender, duration of anesthesia and the recovery time of the child.

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