

Temperature elevation in children following dental treatment under general anesthesia with or without prophylactic antibiotics

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Abstract

Bacteremia, tissue damage, and dehydration are mentioned frequently as factors that might be responsible for postoperative temperature elevation (PTE). In a prospective, randomized, double-blind, placebo-controlled study, the influence of a single dose of oral amoxicillin administered 1 hr prior to the procedure on PTE was examined. Twenty-six healthy children (21 boys and 5 girls) 2 to 5 years old, who received dental treatment under general anesthesia (GA) were evaluated. Anesthesia was maintained with nitrous oxide and Fluothane and the patients were well-hydrated intravenously during the procedure. Half of the children received prophylactic antibiotic 1 hr prior to the procedure. The other half received a flavored syrup as placebo. Thirteen patients (50%) presented PTE (rectal temperature $\geq 37.9^{\circ}\text{C}$) 2–5 hr after extubation. The results were statistically analyzed using ANOVA. However, no association was found between PTE and antibiotic administration or any of the parameters investigated such as, number of dental procedures, type of treatment performed, patient's weight, or change in temperature during dental treatment. (Pediatr Dent 15:99–103, 1993)

Introduction

General anesthesia (GA) is an acceptable option for child patients in whom conscious sedation techniques are inadequate to control disruptive behavior, and the dental treatment cannot be accomplished.^{1,2} Full mouth dental rehabilitation is performed to avoid repetition of the GA procedure, resulting in an extensive dental treatment completed in a short period of time. Dental treatment under GA involves several postoperative complications, one of them being elevation of body temperature.^{3–6} A preliminary survey performed by the authors revealed that 10 of 19 children presented transient postoperative temperature elevation 2–5 hr following complete mouth rehabilitation under GA.

A common sequela of dental manipulation is in fact a transient phase of bacteremia.⁷ Bacterial invasion into the blood circulation occurs due to traumatic nasotracheal intubation and is more likely to occur in patients with poor oral hygiene and extensive dental procedures.⁶ Extraction of infected teeth will allow more organisms to invade the blood stream than a simple Class I restoration. Bacteremia, tissue damage, and dehydration are mentioned frequently as factors that might be responsible for postoperative temperature elevation (PTE).^{4–6} It was suggested that if bacteremia causes temperature elevation, antibiotic prophylaxis should prevent it. A short-term antibiotic treatment is a recommended regimen to prevent infectious endocarditis because of dentally related bacteremias.⁸

The purpose of the present prospective, randomized, double-blind study was to examine the influence of a single dose of antibiotics administered 1 hr prior to the dental procedure on the patient's temperature following full mouth rehabilitation under GA.

Methods and materials

Participants in this study were 2- to 5-year-old children in good health referred for treatment under GA because of extreme uncooperative behavior and the need for extensive dental treatment. The study design was approved by the human subjects committee and the procedures, possible discomforts or risks, as well as possible benefits were explained fully to the parents, and their informed consent was obtained prior to the investigation. The patients were the first 26 referred children from the beginning of the study who met the above mentioned criteria. None of the parents refused to participate. The patients were divided randomly into two groups using a computerized randomization table. The study group received a single oral dose of amoxicillin syrup 25 mg/kg body weight 1 hr prior to the dental procedure. Erythromycin 20 mg/kg was a possible alternative antibiotic for cases of known hypersensitivity to penicillin, but was not needed. The control group received a flavored syrup as placebo. The antibiotic or placebo, provided by one of the investigators (DE) with only the patient's name and code number, was administered by an RN not participating in the treatment. The anesthesiologist, the dental team, and the parents were unaware of the group to which the patient was assigned. The code was broken only at the end of the study.

A comprehensive record chart included:

- Demographic data
- Difficulties, or bleeding during intubation
- Duration of anesthesia and dental procedure
- Numbers of teeth treated and type of dental treatment
- Body temperature.

The temperature was measured rectally with a mercury thermometer by one of the treating team just before administering the premedication, at the beginning and end of the anesthetic procedure, and every hour thereafter until the patient was discharged. Parents were given the same thermometer and were instructed to measure the child's temperature rectally every 2 hr until bedtime. A printed form was given to the parents to record the temperature. The highest temperature measured after the end of the anesthetic procedure represented the postoperative temperature of the patient and—if increased above 37.8°C was defined as PTE. The normal set-point for most humans ranges between 36° and 37.8°C,⁹ therefore a temperature of 37.9°C and above was regarded as PTE.

Parents were instructed to ensure preoperative NPO from midnight. The GA was induced by a trained anesthesiologist following the administration of pentothal suppository as premedication. Anesthesia protocol and concentration were almost consistent among patients. Nasotracheal intubation was performed using phenylephrine 1% nasal drops followed by lidocaine 1.5% spray. No muscle relaxant was used. Any possible leaks were sealed with a damp gauze pack inserted to the pharynx. Anesthesia was maintained with intermittent positive pressure ventilation (IPPV) using nitrous oxide and Fluothane® (Ayerst Laboratories, New York, N.Y.). Intravenous infusion of 4.3% glucose in 0.45% solution drip was maintained during the anesthetic phase and at the recovery room to prevent dehydration. The rate of the IV drip was calculated according to the fasting period and the child's weight. The operating room was kept at a temperature ranging from 22° to 25°C by air conditioning.

The dental procedure was performed by a postgraduate resident and a senior pediatric dentist. Treatment began during the morning hours. A rubber dam was placed to isolate the teeth during dental treatment.

The patients were kept in the recovery room for observation and discharged on the same day when full recovery was achieved, or hospitalized if postoperative complications were identified.

The ANOVA test was used to detect any influence of different variables on temperature elevation.

Results

Twenty-six children (21 boys and 5 girls) participated in the study. Their weight ranged between 10 and 19 kg (mean 14.5 kg) with no significant difference between the antibiotic or placebo groups. In no case did the anesthesiologist report any difficulty during intubation, and tube insertion caused bleeding from the nasal mucosa in only two cases.

Thirteen patients (50%) presented PTE (temperature equal or exceeding 37.9°C). The distribution of patients with or without PTE was similar in the two groups whether or not amoxicillin was administered (Table 1). No significant difference was found between the study and the control groups ($P > 0.05$). PTE was found in two of five

Table 1. Distribution of patients with or without postoperative temperature elevation (PTE) by study and control groups

Study group	Postoperative Temperature	
	≤ 37.5°C	≥ 37.9°C
Antibiotics	7	6
Control group		
Placebo	6	7
Total	13	13

girls (40%) and 11 of 21 boys (52%).

The PTE resolved following a single dose of a mild antipyretic medication. Two patients were kept in the hospital till the next morning due to high temperature accompanied by coughing. The figure presents the mean temperature of the children in the Amoxicillin and placebo groups at the different stages of the treatment: just before administration of the premedication (baseline), at the beginning (initial), and end (end) of the anesthetic procedure, and the highest postoperative temperature (postop). A drop in body temperature from initial to end was found in 18 patients (70%), a rise in six patients (23%) and two others presented no change. Drop in body temperature was more often observed than rise and its extent was larger. PTE ($\geq 37.9^\circ\text{C}$) was observed between 2 and 5 hr after extubation, both in children whose body temperature dropped (10 patients) and raised (three patients) from initial to end the anesthetic procedures.

Table 2 shows the number of teeth treated, type of treatment performed, and the appearance of PTE. Of 13 patients presenting PTE, six had teeth extracted and seven had no extractions. Three patients had extractions but did not experience PTE. The number of teeth treated per pa-

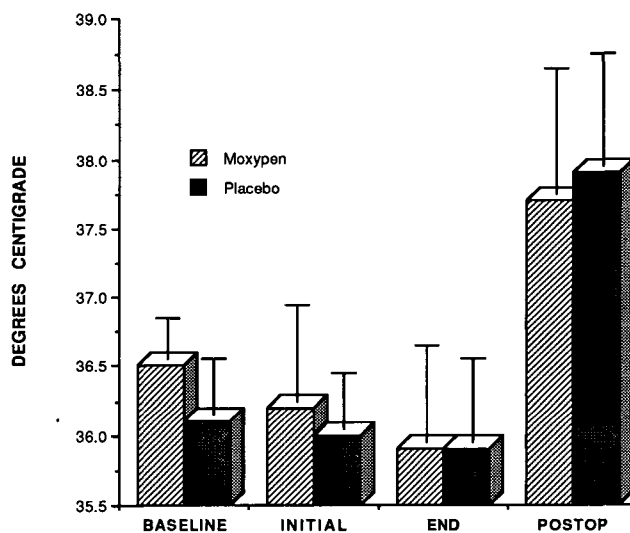


Fig. The mean temperature of the children in the Amoxicillin and placebo groups at different stages of the treatment.

Table 2. Number of teeth treated according to type of dental procedure and PTE

	Case	Fillings	Crowns	Pulpotomy	Extracted	Total Number of Procedures	PTE (°C)
Study	1	1	10	1	0	12	No (37.6)
	2	3	5	1	0	9	No (36.8)
	3	2	10	1	4	17	No (35.5)
	4	6	4	1	4	14	Yes (37.9)
	5	3	2	0	4	9	Yes (39.2)
	6	6	2	1	0	8	Yes (37.9)
	7	2	3	2	0	5	Yes (38.7)
	8	7	3	1	0	11	No (37.8)
	9	3	2	5	1	11	No (37.8)
	10	7	3	3	0	13	No (37.4)
	11	1	5	0	0	6	No (37.4)
	12	8	3	1	0	11	Yes (38.5)
	13	9	2	0	4	15	Yes (38.0)
Controls	14	4	6	2	0	12	No (37.8)
	15	3	5	1	0	9	Yes (38.5)
	16	1	7	0	0	8	Yes (38.5)
	17	3	4	0	0	7	Yes (37.9)
	18	6	4	1	0	11	No (37.5)
	19	2	4	2	0	8	No (37.7)
	20	8	2	0	3	13	Yes (38.6)
	21	3	4	2	0	7	Yes (39.5)
	22	2	4	2	0	8	No (36.7)
	23	5	5	1	0	11	No (36.2)
	24	1	3	0	2	6	No (36.2)
	25	7	5	0	5	17	Yes (38.0)
	26	6	0	0	5	11	Yes (38.3)

tient ranged between six and 17, with an average of 9.54. Six patients with PTE had more teeth treated than the average and seven had less. Seven patients who had more teeth treated than the average did not experience PTE. No association was found between these factors and PTE.

Table 3 shows the mean postoperative temperature and the percentage of children with PTE by selected variables. For statistical evaluation by ANOVA the children were divided as equally as possible for each selected variable into two groups either by "yes" or "no" or by numbers into a lower and a higher half. Of the selected variables, a statistically significant difference was found between children who had or did not have a pulpotomy procedure. None of the other selected variables even approached statistical significance.

Discussion

Bacteremia was suggested as a possible etiology for temperature rise in children undergoing full mouth rehabilitation under GA.^{5,6} Bacteremia resulting from seeding

of nasopharyngeal organisms into circulation during intubation is brief and can be eliminated with a short-term use of antibiotics.⁷ The daily therapeutic dose of amoxicillin is 40 mg/kg body weight. The prophylactic dosage of amoxicillin given to prevent infectious endocarditis is "overshooting" of medication that expresses the need to prevent the danger at "any cost." Therefore, the dosage of 25 mg/kg used in the study seems to be adequate. In our study no correlation was found between antibiotic premedication and PTE. Although repeated blood cultures were not obtained from the patients (due to their age), our observations suggest that bacteremia is probably not the major cause of PTE. The results this study agree with those of Morrow et al.⁶ who reported 45% PTE and found no association between temperature elevation and conditions more likely to lead to bacteremia such as high oral hygiene index and gingival index scores, tissue damage, and teeth extractions. Furthermore, if bacteremia induced during an operation is a possible underlying cause for fever, one would expect to find PTE following ENT

Table 3. Percentage of children with PTE by selected variables

<i>Variables</i>		<i>N</i>	<i>Mean Postoperative Temperature (SD)</i>	<i>% of Children with PTE</i>	<i>P Value</i>
Amoxicillin	Yes	13	37.9 ± (0.8)	53.9	0.71
	No	13	37.7 (0.9)	46.1	
Weight*	≤ 14.5	11	38.0 (1.0)	54.5	0.70
	≥ 15.0	13	37.7 (0.8)	46.2	
Total number of procedures	≤ 10	12	37.9 (1.0)	58.3	0.45
	≥ 11	14	37.7 (0.7)	42.9	
Restorations	1-3	14	37.7 (1.0)	42.9	0.45
	4-9	12	38.0 (0.4)	58.3	
Crowns	0-3	11	38.0 (0.8)	63.6	0.25
	4-10	15	37.7 (0.9)	40.0	
Pulpotomies	0	9	38.0 (0.9)	77.8	0.04†
	1-5	17	37.7 (0.9)	35.3	
Extractions	0	17	37.9 (0.7)	41.2	0.23
	1-5	9	37.7 (1.0)	66.7	
Baseline temperature	≤ 36.3	14	37.8 (0.7)	57.1	0.45
	≥ 36.4	12	37.8 (1.0)	41.2	
Initial temperature	≤ 36.2	13	37.7 (1.0)	46.1	0.71
	≥ 36.3	13	38.0 (0.7)	53.9	
End temperature	≤ 35.8	13	37.7 (0.9)	46.1	0.71
	≥ 35.9	13	37.9 ± (0.9)	53.9	

* Missing data of two children. † Statistically significant (ANOVA).

interventions. However, no reports of such findings were found in the literature.

Association between PTE and the patient's weight, duration of the dental procedure as expressed by the total number of procedures performed, and initial, final, and change of temperature from beginning to end of the dental treatment also were investigated. However, PTE observed in the present study could not be attributed to any of these parameters. Since only five girls participated in the study, and despite randomization, none of them received antibiotics, no conclusion can be made regarding the influence of gender on PTE. The statistical difference found for the percentage of children with PTE by the pulpotomy procedure was paradoxical in that the percentage was higher in those that did not have this treatment.

When the anesthetic procedure began, the patients had no food or drink for about 9-11 hr, and thus could be dehydrated. Dehydration was mentioned as a possible cause for temperature elevation.^{3,6} Nazif³ attributed the high incidence of fever in his study to insufficient fluid infusion. In our study dehydration can be ruled out as the etiology for PTE since IV infusion continued throughout the treatment and after extubation in the recovery room.

Weil¹⁰ stated that the most common pulmonary complication that produced PTE is atelectasis. Atelectasis is the imperfect expansion or collapse of portion of a lung and may be due to continuous decrease in the amplitude of respiratory excursion.¹¹ Such an event may occur during the general anesthetic procedure in children — especially when intermittent positive pressure breathing is not employed to ventilate the collapsed alveoli. It is not reasonable to assume that atelectasis occurred during GA in our study since IPPV was applied. However, atelectasis may develop in the postoperative stage¹² as a result of anesthetic agents that depress the normal mucociliary clearance of airways, and that may cause the PTE observed in this study.

The pattern of temperature decrease during the GA was described previously.¹³ This intraoperative hypothermia results from the suppressed thermoregulatory mechanism, temperature loss to the environment, impaired temperature gain, and decreased metabolic rate.¹ During anesthesia the temperature threshold in the hypothalamus is decreased.¹⁵ At a later stage during post anesthetic recovery of the central thermoregulation mechanism, the temperature threshold increases again. Is PTE an expres-

sion of delayed recovery of the thermoregulation mechanism? Is PTR the body's response to the hypothermic stage? Of the 18 patients who experienced hypothermia during anesthesia, 10 presented PTE of 37.9°C or higher.

Morrow et al.⁶ studied a group of patients 1.5 to 17 years old who received dental treatment under GA. They found significant temperature elevation to occur in the 1- to 5-year-old group. The range of the patients' age in the present study (2 to 5 years) was not wide enough to distinguish between the younger and the older patients. Morrow's findings might suggest that the postanesthetic recovery period of the thermoregulatory mechanism in the young child is longer. PTE thus may be an expression of the higher upper threshold of the suppressed regulatory mechanism and the transient nature of the fever.

Conclusion

The present study showed that a single dose of amoxicillin 1 hr before the treatment failed to prevent postoperative temperature elevation following full mouth dental rehabilitation under general anesthesia. This suggests that bacteremia was not the cause of postoperative temperature elevation. As none of the selected variables seemed to be the cause of PTE in this study it was suggested that physiological effects of the general anesthesia on temperature control in young children should be examined.

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