

**COMPLICATIONS IN CHILDREN UNDERGOING DENTAL TREATMENT  
UNDER GENERAL ANESTHESIA**

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**APPROVAL**



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# COMPLICATIONS IN CHILDREN UNDERGOING DENTAL TREATMENT UNDER GENERAL ANESTHESIA

## ABSTRACT

A retrospective review of the medical and dental records of 30 ASA class 1 pediatric patients undergoing complete dental care under general anesthesia was performed. The patients were evenly distributed between males and females, had a mean age of 44 months and underwent a mean of 8.7 restorations, 1.2 extractions and 2.0 pulpal therapies. Patients spent an average of 198 minutes in the operating room, 178 minutes intubated, 38 minutes in the post-anesthesia recovery unit and 118 minutes on the pediatric ward. All patients received halothane and nitrous oxide for general anesthesia, 93% received acetaminophen in the operating room and 53% received narcotic medications. No deaths or major complications occurred. Eleven of 30 (37%) patients had one or more minor complications. Four of 30 (13%) patients sustained minor intra-operative trauma; 5/30 (17%) had emesis post-operatively. Four patients had mild pyrexia (temperatures ranging between 38.1°-38.4° C.) post-operatively. Patients with emesis had significantly longer post-operative times than those without emesis (mean of 201 minutes versus 147 minutes,  $p=0.03$ ). All patients who had emesis either sustained minor trauma intra-operatively (2/5) or received narcotic medications (3/5). Comprehensive dental care under general anesthesia in ASA class 1 pediatric patients appears to be safe. Prophylactic use of acetaminophen to reduce the risk of post-operative pyrexia and avoidance of narcotic medications to reduce the risk of emesis should be considered.

# COMPLICATIONS IN CHILDREN UNDERGOING DENTAL TREATMENT UNDER GENERAL ANESTHESIA

## INTRODUCTION

The use of general anesthesia for the treatment of selected pediatric dental patients is a widely accepted practice (Enger and Mourino, 1985; France, 1989; Holst, 1965; Nazif, 1976). While most pediatric dental patients do not require general anesthesia, there are patients in whom general anesthesia is preferable for dental treatment. Children who are medically compromised, present difficult management problems or require extensive treatment are ideal candidates for dental treatment under general anesthesia (Legault et al, 1972).

General anesthesia for a variety of surgical procedures in children has a low rate of serious complications. With current anesthesia and surgical techniques, the rate of perioperative death in pediatric patients is very low, typically less than 1 case per 10,000 (Motoyama, 1990). Non-fatal perioperative complications (morbidity) occur commonly, affecting perhaps 35% of patients, but generally are not serious (Cohen et al, 1990; Steward, 1973). The most common complications in the intraoperative period are arrhythmias, airway obstruction and other respiratory problems, and hypotension/hypertension. Common complications affecting children in the immediate postoperative period include nausea and vomiting, laryngospasm, airway obstruction and other respiratory problems, and pyrexia (Berry, 1986; Jerome, 1989). Given an appropriate indication, surgical

dental treatment under general anesthesia in a predominantly non-medically compromised population. Enger and Mourino surveyed 200 pediatric dental patients receiving general anesthesia in which 93.5% were either American Society of Anesthesiologist (ASA) class 1 or 2 patients (Enger and Mourino, 1985). No deaths or serious complications occurred in this series of patients. The most common complication was nausea with vomiting, which affected 36% of the patients. Other complications included pyrexia (12%), and cough and sore throat (8%). Most (93%) of the complications occurred on the day of surgery with the remainder occurring the next day. This single study suggests that the rate and spectrum of complications of general anesthesia for dental treatment in healthy children is similar to that of children undergoing other surgical procedures.

There is a national trend toward using hospital general anesthesia in place of dental office sedation for the treatment of healthy children (Boharty and Spencer, 1992). Additional information documenting the safety of dental treatment under general anesthesia for healthy children is therefore needed. This study retrospectively assessed the postoperative complications in 30 ASA class 1 children undergoing dental treatment utilizing general anesthesia in a one year period.

## **MATERIALS AND METHODS**

### *Records Review*

Medical and dental records from 30 randomly selected ASA 1

pediatric patients that underwent comprehensive dental care under general anesthesia at Oregon Health Sciences University Hospital between July 11, 1991, and June 29, 1992, were reviewed. An ASA 1 patient is defined as a normal, healthy patient free of systemic disease (Owens et al, 1978). For each patient, the following information was obtained from the records: age in months; sex; number of pulpal therapies, extractions and dental restorations (including all amalgams, stainless steel crowns and composites); pre- and intra-operative systolic and diastolic blood pressures (BP); pre-, intra- and post-operative temperatures; intra- and post-operative O<sub>2</sub> saturation; number of times intubated; amount of time in the operating room (OR), time intubated, time in the post-anesthesia care unit (PACU) and time on the pediatric ward until discharge; medications; complications. The following were considered to be complications: trauma; intra-operative systolic or diastolic BP changes requiring intervention; intra- or post-operative pyrexia defined as a temperature of  $\geq 37.9^{\circ}\text{C}$  (Holan et al, 1993); O<sub>2</sub> saturation less than 91% (Lanigan, 1992); any other untoward or unexpected result, such as death, intravenous infiltrations, and pharyngitis.

#### *Statistical Analysis*

Coded data was entered into a personal computer and processed. The following statistical analyses were performed: descriptive statistics (mean, standard deviation, range) for all parameters; Pearson's r for correlations; paired and unpaired t



tests. Values that fell outside of 95% confidence levels were considered significant.

## **RESULTS**

### *Patient and Treatment Characteristics*

The mean age of the patients was 44 months (range, 17-185 months) (Table 1), and the sex of the 30 patients was evenly split between males and females. The most common procedures performed were dental restorations; all patients had at least one restoration and the mean number of restorations was 8.7 (range, 1-17). Extractions and pulpal therapies were less commonly performed; the mean number of extractions was 1.2 (range, 0-4) and mean number of pulpal therapies was 2.0 (range, 0-5).

### *Intra- and Post-operative Times*

Patients spent an average of 198 minutes in the OR (range, 70-320) (Table 1). Most patients underwent a single intubation, but 6/30 underwent two intubations because the initial endotracheal tube was the wrong size or misplaced. Extubation and re-intubation was performed expeditiously in all six patients. Patients were intubated an average of 178 minutes (range, 60-305), and all patients were extubated in the operating room. The total post-operative time averaged 156 minutes (range, 75-235); patients spent a mean of 38 minutes in the PACU (range, 5-85) and 118 minutes on the pediatric ward (range, 50-205). All patients were discharged from the hospital on the day of surgery.

### *Medications*

Table 2 lists the medications given to patients as part of

their treatment. All patients received halothane and nitrous oxide for general anesthesia. In addition, some patients also received sodium thiopental or isoflurane after halothane induction. Two-thirds of patients received a muscle relaxant, which was either vecuronium or pancuronium. About one-half of the patients received midazolam as a preinduction sedative. Almost all (93%) of the patients received in the operating room acetaminophen rectally. Slightly more than one-half (53%) of patients received narcotics, either fentanyl, morphine or both, intra-operatively.

#### *Complications*

No deaths or major complications occurred among the 30 patients. Eleven of 30 patients (37%) had one or more minor complications and these happened in both the operating room and the post-anesthesia care unit (Table 3). Intra-operative trauma occurred in 4/30 (13%) patients. One patient had lip edema and a fractured tooth; one had lip edema; one had trauma to the uvula; and one had minor bleeding in the pharynx. The only other intra-operative complication was mild pyrexia in one patient.

The only complications that occurred post-operatively were emesis and pyrexia. Emesis occurred in the post-anesthesia recovery unit in 5/30 (17%) patients, including two patients who also had trauma in the operating room. Only one patient with emesis was treated with an anti-emetic. Significant temperature elevations (rectal temperature  $\geq 37.9^{\circ}\text{C}$ ) occurred in 4/30 (13%) patients. All four patients had elevated temperatures post-

operatively, including the one patient who had had pyrexia intra-operatively. Temperature elevations were mild in all patients, ranging between 38.1° and 38.4°C. All patients with temperature elevations received acetaminophen approximately 30 minutes before leaving the operating room.

Pre-operative blood pressures (BP) were available for only 20 of the patients. Among these 20, 18 experienced intra-operative BP changes of  $\pm 20\%$  from their pre-operative BP. Nine of 20 had maximum systolic or diastolic BP that were 20% or higher than their pre-operative pressures. Among these patients, maximum systolic BP ranged between 104mm Hg and 152mm Hg and maximum diastolic BP ranged between 50mm Hg and 80mm Hg. Twelve of 20 patients had minimum systolic or diastolic BP that were 20% or lower than their pre-operative BP. Among these patients, minimum systolic BP ranged between 80mm Hg and 66mm Hg and minimum diastolic BP ranged between 30mm Hg and 45mm Hg. However, while intra-operative BP changes were quite common, none of these intra-operative BP changes were considered clinically significant and did not require any intervention.

No patients had decreases in their O<sub>2</sub> saturation below 95%. O<sub>2</sub> saturations of two patients fell to 95%, three fell to 96%, four to 97%, eight to 98% and six to 99%. All of these changes were for brief periods and none required intervention.

#### *Correlations*

Time in the operating room correlated with total number of restorations ( $r=0.473$  with  $p=0.008$ ) and total number of pulpal

treatments ( $r=0.503$  with  $p=0.004$ ) but did not correlate with total number of extractions or age of patient (Table 4). Total post-operative time (time in post-anesthesia recovery unit plus time on pediatric ward) did not correlate with any of the following: number of restorations, pulpal treatments or extractions; age of patient; time in operating room; BP,  $O_2$  saturation; or temperature changes.

Emesis was significantly related to the total post-operative time ( $p=0.03$ ). The mean total post-operative time of patients with emesis was 201 minutes while it was 147 minutes for patients without emesis. Emesis did not correlate with other measured parameters. However, two of the patients with emesis sustained trauma intra-operatively: one patient who had a fractured tooth and lip edema and another who experienced minor bleeding. The other three patients with emesis were among the 16 patients who received narcotics, although there was no statistically significant correlation between the use of narcotics and emesis.

## DISCUSSION

In this retrospective review of medical and dental records, comprehensive dental treatment under general anesthesia in ASA class 1 pediatric patients was found to be a safe procedure. There were no major complications or deaths among 30 patients, although one or more minor complications occurred in 33% of patients. These results are consistent with previous studies that documented the safety of comprehensive dental treatment



under general anesthesia in ASA class 1 and higher pediatric patients (Greene and Falcetti, 1974; Libman et al, 1979; Enger and Mourino, 1985).

The findings presented here compare favorably with those of the one previous report on dental care under general anesthesia in healthy pediatric patients (Enger and Mourino, 1985). As in the present series of patients, there were no deaths or serious complications in Enger and Mourino's series of 200 patients, including 108 ASA class 1 patients. The present case series had a higher rate of trauma than that of Enger and Mourino (13% versus 5%). The reason for the higher rate of trauma in the present series is uncertain. About one-half of the patients in the previous case series received their care at a non-teaching, private hospital and the others at a teaching, private hospital. Resident anesthesiologists performed all intubations in the present series, and it is possible that the higher rate of trauma with intubation was related to less experienced physicians performing the intubations. Alternatively, it is possible that the criteria used for trauma in the present study differed from that of Enger and Mourino and included more cases of minor trauma, such as lip edema and minor pharyngeal bleeding.

Incidences of post-operative pyrexia (13% and 12%, respectively) were similar to those reported by Enger and Mourino. A lower incidence of vomiting (17% versus 36%) was found compared to that reported by Enger and Mourino. It is unclear what explains the lower incidence of emesis in the

present case series. The use of narcotic medication may influence the risk of emesis, and the report of Enger and Mourino provides little information on the medications that were administered to their patients. It is possible that narcotics or other medications with nausea and emesis as a side effect were more commonly used in their case series than in the present series. Overall, the rate of complications of the present case series compares favorably with that of Enger and Mourino and supports their conclusion that dental care under general anesthesia is safe.

Emesis is a well recognized minor complication occurring in pediatric patients undergoing general anesthesia (Berry, 1986; Jerome, 1989). In the present series, 17% of patients experienced emesis in the post-operative period. While emesis usually is not a serious complication, it is uncomfortable for patients and puts them at risk for aspiration, which can be serious. In addition, as demonstrated in the present case series, emesis prolongs the time of post-operative recovery and, in the present series, patients with emesis had longer total post-operative times than those without emesis.

The small sample size of this study limited the ability to find statistically significant correlations with emesis. However, all five patients who experienced emesis either had intra-operative trauma (2/5) or received fentanyl or morphine in the operating room (3/5). Minor trauma in the operating room before placement of a throat pack might predispose patients to vomiting

post-operatively because of pain or gastric irritation caused by blood. Emesis is a well recognized complication of narcotic medications like fentanyl and morphine (Jaffe and Martin, 1990). Thus emesis in individual patients may have resulted from intra-operative trauma, the use of narcotic medications or a combination of both. Slightly more than half of the cases received fentanyl or morphine, and it was uncertain why some patients received narcotic medications and others did not. Avoiding narcotic medications and reduction of trauma caused by intubation together might lower the risk of post-operative emesis.

Post-operative pyrexia is a well recognized complication of patients undergoing dental care under general anesthesia, occurring in 25-98% of patients (Nazif, 1976; Libman et al, 1979; Enger and Mourino, 1985; Morrow et al, 1986; ). The cause of post-operative pyrexia is uncertain and may relate to bacteremia, tissue trauma, dehydration, medications, or abnormalities of thermoregulation following general anesthesia (Morrow et al, 1986; Holan et al, 1993). Prophylactic administration of antibiotics did not reduce the incidence of pyrexia post-operatively (Holan et al, 1993). The present study found that pyrexia in the immediate post-operative period occurred in only 13% of cases and was always less than 39°C. This is considerably less than that reported in the series reviewed by Libman and colleagues in which 43% of patient had post-operative temperature elevations (Libman et al, 1979). The low rate of post-operative

temperature elevation found is likely the result of the nearly universal use of acetaminophen (in 93% of cases).

Comprehensive dental care under general anesthesia for ASA 1 pediatric patients appears to be a safe procedure. Despite the safety of the procedure, minor complications occur in a significant number of patients. Future studies with larger sample sizes are indicated to help identify risk factors for these minor complications. Such information might result in changes in practice that could further reduce the incidence of complications among children undergoing dental procedures under general anesthesia. Based on the results presented here, the prophylactic use of acetaminophen to reduce the risk of post-operative hyperpyrexia and the avoidance of narcotic medications to reduce the risk of post-operative emesis should be considered.



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## TABLES

Table 1. Patient and Treatment Characteristics

	Age	Rest.	Ext.	Pulp.	OR Time	Intub. Time	PACU Time	Ward Time	Total Postop. Time
Mean	44	8.7	1.2	2.0	198	178	38	118	156
SD	30	3.8	1.7	1.7	60	59	17	49	51
Min.	17	1.0	0	0	70	60	5	50	75
Max.	185	17.0	4.0	4.0	320	305	85	205	235

Ages are given in months. All times are in minutes.

SD, standard deviation

Min., minimum

Max., maximum

Rest., restorations (total number)

Ext., extractions (total number)

Pulp., pulpotomies (total number)

OR, operating room

Intub., intubation

PACU, post-operative acute care unit

Postop., postoperative (equals time in PACU plus time on ward)

**Table 2. Medications Used**

Medication	# of Patients
General Anesthetics	
Halothane/Nitrous oxide	30 (100%)
Ketamine	1 (3%)
Sodium thiopental	2 (7%)
Isoflorane	21 (70%)
Preinduction Agent	
Midazolam	16 (53%)
Muscle Relaxants	
Vecuronium	17 (57%)
Pancuronium	3 (10%)
Anticholinergic	
Atropine	7 (23%)
Narcotics	
Morphine sulphate	6 (20%)
Fentanyl	11 (37%)
Anti-pyretics	
Acetaminophen	28 (93%)
Miscellaneous	
Edrophonium	1 (3%)
Droperidol	1 (3%)
Inapsine	1 (3%)
Phenergan	1 (3%)

**Table 3. Complications**

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Intra-operative	# of Patients
Fractured tooth	1 (3%)
Trauma to uvula	1 (3%)
Minor bleeding	1 (3%)
Lip edema	2 (7%)
Pyrexia	1 (3%)
Post-operative	
Emesis	5 (17%)
Pyrexia	4 (13%)

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Some patients experienced more than one complication. One patient had both a fractured tooth and lip edema intra-operatively and emesis post-operatively. One patient had minor bleeding intra-operatively and emesis post-operatively. One patient had trauma to the uvula and post-operative emesis. One patient had pyrexia intra- and post-operatively.

**Table 4. Correlation Analysis**

Variable 1, Variable 2	R-Value	P-Value
Postop. Time, # Ext.	-.283	.1308
Postop. Time, OR Time	.011	.9562
Postop. Time, Age	.265	.1578
Postop. Time, O <sub>2</sub> Sat. OR	-.123	.5218
Postop. Time, O <sub>2</sub> Sat PACU	.134	.5007
Postop. Time, # Pulp.	-.166	.3840
Postop. Time, # Rest.	.027	.8892
# Ext., OR Time	.004	.9826
# Ext., Age	-.120	.5311
# Ext., O <sub>2</sub> Sat. OR	.277	.1402
# Ext., O <sub>2</sub> Sat. PACU	-.113	.5717
# Ext., # Pulp.	.035	.8571
# Ext., # Rest.	-.319	.0860
OR Time, Age	.252	.1806
OR Time, O <sub>2</sub> Sat. OR	.075	.6951
OR Time, O <sub>2</sub> Sat. PACU	.053	.7911
OR Time, # Pulp.	.503	.0040*
OR Time, # Rest.	.473	.0075*
Age, O <sub>2</sub> Sat. OR	.056	.7689
Age, O <sub>2</sub> Sat. PACU	.071	.7215
Age, # Pulp.	.238	.2068
Age, # Rest.	.097	.6118
O <sub>2</sub> Sat. OR, O <sub>2</sub> Sat. PACU	.069	.7295
O <sub>2</sub> Sat. OR, # Pulp.	.022	.9098
O <sub>2</sub> Sat. OR, # Rest.	-.062	.7485
O <sub>2</sub> Sat. PACU, # Pulp.	-.004	.9839
O <sub>2</sub> Sat. PACU, # Rest.	.178	.3689
# Pulp., # Rest.	.127	.5084

**Table 4. Correlation Analysis (cont.)**

\* significant correlations ( $p \leq 0.05$ ); all other correlations are not significant.

Postop., postoperative

Rest., restorations (total number)

Ext., extractions (total number)

Pulp., pulpotomies (total number)

OR, operating room

Intub., intubation

PACU, post-anesthesia acute care unit

Sat., saturation