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The Effect of Propofol and Fentanyl as Compared with Sevoflurane on Postoperative Vomiting in Children after Adenotonsillectomy

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A B S T R A C T

Postoperative vomiting (PV) after adenotonsillectomy in children is a common problem with an incidence as high as 40–80%. Only few studies in the recent literature compared the effect of different anesthetic techniques concerning PV in children. The aim of this study was to compare the incidence of PV in two groups of children who underwent two different general anesthesia techniques in order to determine what type of anesthetic technique is more related to less PV. The clinical trial included 50 children (physical status ASA I, 3–12 years old) divided into 2 groups and monitored for PV 24 hours following the surgery. Group one (G1) consisted of 25 children who underwent general anesthesia with gas mixture 60% nitrous oxide and 40% oxygen and anesthetic propofol, opioid fentanyl and muscle relaxant vecuronium intravenously and group two (G2) included 25 children to whom volatile anesthesia with sevoflurane in the same gas mixture was given. Demographic characteristics (gender, age, weight, history of motion sickness and earlier PV) as well as surgical data (length of surgery and anesthesia, intraoperative blood loss) were recorded. There were no significant differences considering demographic characteristics and surgical data between the investigated groups. The incidence of PV was relatively low 3 children (12%) in G1 group and 5 children (20%) in G2 group. Statistically there was no significant difference between the groups regarding the incidence of PV and both anesthetic techniques can be used equally safe regarded to PV.

***Key words**: postoperative vomiting, adenotosillectomy, anesthetic technique, propofol, fentanyl, sevoflurane*

Introduction

Adenotonsillectomy is still one of the most common surgical procedures in children. Postoperative nausea and vomiting (PONV) are the most frequent and unpleasant complications in children following adenotonsillectomy. Vomiting is a physical phenomenon of a forceful expulsion of gastric contents from the mouth. It may lead to dehydration, electrolyte imbalance, bleeding, delayed discharge and unplanned hospital admission[1]. Anesthetic, nonanesthetic and postoperative factors have been associated with an occurrence of postoperative vomiting (PV)[2,3]. Adenotonsillectomy is associated with an incidence of PV as high as 40–80%[4,5]. Anesthesiologists are searching for cost effective medications and anesthetic techniques that will minimize this problem. Anticholinergics (transdermal scopolamine), antihistamines (dimenhydrinate), benzamides and benzimidazole derivatives (metoclopramide, trimethobenzamide), butyrophenones (droperidol), phenothiazines (dixyrazine, promethazine, perphenazine), serotonin antagonists (on-dansetron, granisetron, dolasetron, tropisetron), steroids (dexamethasone), H1 and H2 blocking agents, anesthetic propofol and supplemental oxygen are all effective to various de-

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grees in reducing vomiting after surgical operations[4–20]. Many antiemetic drugs have been studied whereas less attention has been paid to the effects of the applied anesthetic technique on PV.

We compared the incidence of PV in our patients who underwent general anesthesia with propofol, opioid fentanyl and muscle relaxant vecuronium in comparison with technique using volatile anesthetic sevoflurane. The aim of our research was to determine which of these two anesthetic techniques is safer regarding PV after adenotonsillectomy.

Patients and Methods

The study was carried out at the Department of Otorhinolaringology, General Hospital Zadar, Croatia, from January 2003 to January 2004 and included 50 children classified according to the American Society of Anesthesiologists as physical status ASA I, 3–12 years old. After the informed parents had given their written approval to the procedure, the children underwent elective adenotonsillectomy and were monitored for PV 24 hours following the surgery. Children under 3 years age were not included in the study because propofol is not recommended for their age. Obese children and those with ASA II or greater were excluded from the study because obesity and concomitant diseases can increase the incidence of PV[1–3]. The exclusion criteria included also children to whom steroids were given as well as antiemetics few days before surgery because such drugs lower the incidence of PV[5,10,17]. Tonsillectomy was performed by cold knife technique with bipolar electrocautery and adenoidectomy with conventional curettage technique. Prior to surgery children were not given solids for 6 hours and clear fluids for 3 hours. Midazolam (80 μg/kg) was given intramuscularly for premedication 30 min before the anesthesia induction. The amount of saline administered intraoperatively was 10 ml/kg and during 24 hours depended on blood loss, PONV and oral intake of fluids. Oral clear fluids were given only to children who asked for them but not earlier than 2 hours after the surgery. Intraoperative blood loss was measured by weighting throat packs before and after the operation and by determining the amount of blood in the suction bottle (mL). The length of anesthesia was measured in minutes from the beginning of induction to the discontinuation of nitrous oxide at the end of surgeon's work.

The children were randomized to receive either anesthetics intravenously or inhalational anesthesia. Group one (G1) received fentanyl (2 μg/kg) and propofol (2.5 mg/kg) intravenously. They were manually ventilated during the induction with oxygen and endotracheal intubation was facilitated by vecuronium (0.1 mg/kg). Anesthesia was maintained with small bolus doses of propofol (1 mg/kg) with gas mixture 60% nitrous oxide and 40% oxygen adjusted to maintain heart rate and blood pressure values within 20% of baseline induction value. Ventilation was controlled to keep normocapnia (end tidal CO2 4.8–5.1 kPa). The reversion of neuromuscular blockade was preformed with neostigmine (0.04 mg/kg) in combination with atropine (0.02 mg/kg) and endotracheal extubation was carried out in the left side position when children were awake. Analgetic acetaminophen (25 mg/kg) was given rectally after surgery if necessary.

Children in group two (G2) received anesthesia induction by spontaneously inhalation of gas mixture 5% sevoflurane, 60% nitrous oxide and 40% oxygen via face mask. After intubation anesthesia was maintained with 2–3.5% sevoflurane. Ventilation was controlled to maintain normocapnia (end tidal CO_2 4.8–5.1 kPa). Sevoflurane was discontinued when haemostasis began and nitrous oxide when haemostasis finished. Endotracheal tube was removed in the left side position when the children were fully awake. Acetaminophen (25 mg/kg) was administered rectally few minutes before the induction time and after the surgery if needed.

Metoclopramide (0.15 mg/kg) was administered to children with severe vomiting defined as two or more episodes of PV.

Demographic risk factors for PV as sex, age, weight, history of motion sickness and earlier PV as well as surgical data intraoperative blood loss, length of surgery and anesthesia were all recorded. We investigated these important risk factors in groups G1 and G2 and compared the incidence of PV.

All episodes of PV were noted by nursing staff that was not informed on anesthesia technique used.

Children were discharged from the hospital 24 hours after the surgery if they met the standardized criteria (stabile vital signs, awake, alert, able to swallow, tolerate oral fluid intake, good pain control, without bleeding, without PONV).

The statistic tests used in the study were Mann Whitney U-test and Fisher's exact test and $p<0.05$ was considered statistically significant.

Results

Demographic characteristics, surgical data and incidence of PV are shown in Table 1.

There were no statistically significant difference between G1 and G2 considering demographic characteristics gender, age, weight, history of motion sickness and earlier PV ($p>0.05$) as well as surgical data length of surgery and anesthesia, intraoperative blood loss ($p>0.05$). There were 3 children with one or more episodes of PV in G1 and 5 children in G2. There was no significant difference between these groups regarding the incidence of PV ($p>0.05$, Figure 1).

Metoclopramide was given to a child in G1 with two episodes of vomiting and to 2 children in G2 each of them with three episodes of vomiting. Two children in G1 and 3 children in G2 had a single episode of vomiting.

TABLE 1
DEMOGRAPHIC CHARACTERISTICS, SURGICAL DATA AND INCIDENCE OF POSTOPERATIVE VOMITING

Variable (unit)	Group		p value
	G1 (N=25)	G2 (N=25)	
Gender (N, female/male)	10/15	11/14	ns
Age (years, median, range)	7.0 (4.0–10.0)	6.0 (3.0–10.0)	ns
Weight (kg, median, range)	24.0 (17.0–40.0)	22.0 (14.0–35.0)	ns
Motion sickness and earlier postoperative vomiting (N)	7	2	ns
Length of surgery (minutes, median, range)	20.0 (12.0–45.0)	19.0 (10.0–44.0)	ns
Length of anesthesia (minutes, median, range)	26.0 (17.0–53.0)	24.0 (15.0–45.0)	ns
Intraoperative blood loss (mL, median, range)	23.9 (13.3–36.7)	22.7 (12.6–35.6)	ns
Postoperative vomiting (N)	3	5	ns

ns – not significant (p>0.05), G1 – propofol-fentanyl group, G2 – sevoflurane group

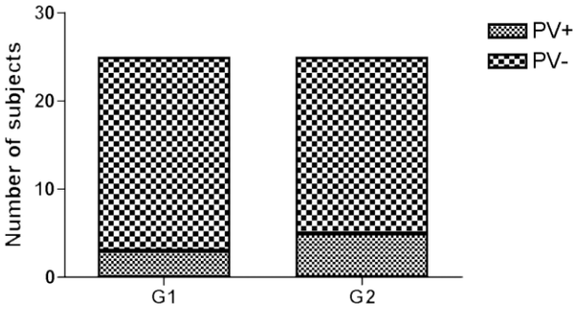

Fig. 1. Number of children with and without postoperative vomiting (PV) in G1(propofol-fentanyl) and G2 (sevoflurane) groups.

Discussion

Many investigators have studied PONV but most of the studies involving children including this one have reviewed only PV because it is difficult to assess nausea in young patients. In this study we considered all patients' characteristics that contribute to the increased incidence of PV. Individual risk factors for PV have been proposed like gender, age, weight, history of motion sickness and earlier PV[21]. It is known that female patients vomit more frequently after surgery and they are particularly at risk during the luteal phase of the menstrual cycle[21,22]. They are 2–4 times more susceptible for PV than men[23]. According to the literature the age of peak incidence of PV is between 6 to16 years[3]. We studied children under 12 years of age and our groups were similar with respect to gender and age.

Surgical factors, type of anesthetics and anesthesia techniques are largely responsible for PV and it is possible that they could be easily influenced[1,17,21]. Operations associated with a high incidence of PV include intra-abdominal, gynecological and breast surgery, laparoscopy, strabismus surgery in children and ENT (ear, nose, throat) procedures[1–3,7,14,24,25]. Children undergoing tonsillectomy are at particular risk for PV after general anesthesia[4,5,10,16,17]. Anxiety can increase the incidence of PV[23]. Midazolam is known to alleviate anxiety and may contribute to decrease of PV[26]. Longer duration of surgery and anesthesia can contribute to the increased incidence of PV because of longer exposure to potentially emetic anesthetics[27]. Neostigmine used for reversal of the muscle relaxant at the end of anesthesia, opioid fentanyl, the volatile anesthetic sevoflurane and nitrous oxide are all medications associated with greater incidence of PV[21,28–32]. The incidence of PV in our propofol group was low and this finding was in concordance with literature where the antiemetic property of propofol undoubtedly contributed to a small incidence of PV[19,21,]. Volatile anesthetics are associated with a greater risk for PV but some investigators found better antiemetic activity of subhypnotic dose of propofol administered at the end of surgery after sevoflurane than after desflurane anesthesia[33]. It is better to avoid inhalational anesthesia in patients with high risk for PV. Apfel et al. have suggested that the leading cause of early postoperative vomiting was the use of volatile anesthetics (isoflurane, enflurane, sevoflurane)[30]. In our sevoflurane group there were only two patients with history of motion sickness which was the contributing factor to the relatively low incidence of PV in this group. Manual ventilation by face mask during the induction time is considered as not important contributing factor for gastric distention and PV[34]. The higher concentration of oxygen administered during the operation can reduce the incidence of PV[20]. We administered 40% oxygen during the anesthesia maintenance. Appropriate rehydration and postoperative pain control decrease the incidence of PV[35,36]. Rehydration and control of pain were standardized in our anesthetic management.

Keidan et al. compared two groups of children who underwent adenoidectomy and tonsillectomy under general anesthesia with propofol infusion in regard to PONV. In that study all children received dexamethasone in premedication. Ketorolac was given intraoperatively to the first group and fentanyl to the second group. The in-

cidence of PONV was low in both groups as the incidence of PV in our study. The cause of such low incidence could be dexamethasone used before surgery. Unlike that study we excluded children who took steroids before surgery to eliminate the possibility of their influence on the results. As in Keidan's study we found that propofol with fentanyl was safe regarding PV in children after adenotonsillectomy[37]. Only few studies in the recent literature compared different anesthetic techniques concerning PV in children. Splinter et al. for example showed that anesthesia induction with propofol was associated with a lower incidence of PV compared to induction with volatile anesthetic halothane. In their study halothane was used for maintenance during tonsillectomy in children[17]. Ved et al. compared 4 types of anesthetic induction and maintenance techniques using nitrous oxide with halothane and/or propofol regarding PV after adenotonsillectomy. They showed that PV occured 3.5 times more often among children who received volatile anesthetic halothane and nitrous oxide compared to children who received propofol and nitrous oxide during anesthesia maintenance[38]. The majority of articles suggest that propofol was associated with less PV than inhalational anesthetics[17,30,38,39]. Gupta et al. searched MEDLINE for the articles published from 1966 to 2002 and found out that PV was significantly associated with the use of isoflurane, desflurane and sevoflurane in contrast to propofol and found no significant difference between sevoflurane versus isoflurane and desflurane in the most of the literature[40]. Our observation that there is a lower incidence of PV in our sevoflurane group (20%) in comparison with the incidence of PV in Ved's study where the halothane was used for induction and maintenance (60%) is in concordance with those studies in the literature that showed a better property of sevoflurane in comparison with other volatile anesthetics regarding the incidence of PV[33,41]. Some other authors like Apfel et al. showed that isoflurane, enflurane and sevoflurane were the main cause of early PV and were associated with almost similar incidence of PV in adults and children[30]. These conflicting data suggest that further investigation is needed to resolve this problem.

According to the recent published data there is no study researching the effect of sevoflurane compared with propofol and fentanyl on postoperative vomiting in children after adenotonsillectomy. In our study we investigated this effect and we could not find statistically significant difference between these two different anesthetic techniques regarding PV ($p>0.05$). We found a lower incidence of PV after adenotonsillectomy compared to the incidence reported in the most of the literature which is as high as 40–80%[4,5,16,17]. These results indicate that surgical technique and anesthetic management we used could be the cause of the lower incidence of PV. Both anesthetic techniques used in our study seem to be safe for the patients regarding PV. The propofol anesthetic technique was associated with nonsignificantly less PV in comparison with newer volatile anesthetic sevoflurane but further investigation with more children included is needed.

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UČINAK PROPOFOLA I FENTANILA U USPOREDBI SA SEVOFLURANOM NA POSLIJEOPERACIJSKO POVRAĆANJE KOD DJECE NAKON ADENOTONZILEKTOMIJE

S A Ž E T A K

Incidencija poslijeoperacijskog povraćanja u djece nakon adenotonzilektomije je velika i iznosi između 40 i 80%. Malo je studija koje su uspoređivale utjecaj različitih anesteziooloških tehnika na poslijeoperacijsko povraćanje u djece. Cilj ovog rada bio je usporediti učestalost povraćanja nakon adenotonzilektomije kod djece s obzirom na dvije različite tehnike opće anestezije i odrediti koja je od primijenjenih anesteziooloških tehnika povezana s nižom incidencijom poslijeoperacijskog povraćanja. Istraživanje je obuhvatilo 50 djece (ASA I, 3–12 godina starosti) koja su bila praćena s obzirom na poslijeoperativno povraćanje tijekom prvih 24 sata nakon adenotonzilektomije. Prva grupa (G1) sastojala se od 25 djece koja su bila anestezirana smjesom 60% dušičnog oksidula i 40% kisika, te intravenskim anestetikom propofolom, opioidom fentanilom i mišićnim relaksatorom vekuronijumom. Druga grupa (G2) sastojala se od 25 djece anesteziranih volatilnim anestetikom sevofluranom u istoj plinskoj smjesi kao i kod G1. Grupe G1 i G2 nisu se međusobno statistički značajno razlikovale s obzirom na demografske osobine (spol, dob, tjelesna težina, kinetoze i ranija poslijeoperativna povraćanja) i kirurške značajke (dužina trajanja operacije i anestezije, gubitak krvi tijekom operacije). U obje grupe je nađena relativno mala učestalost poslijeoperacijskog povraćanja 3 djeteta (12%) u G1 i 5 djece (20%) u G2. Nije nađena statistički značajna razlika s obzirom na učestalost poslijeoperativnog povraćanja između G1 i G2. Obje anesteziološke tehnike su se pokazale jednako pouzdane s obzirom na poslijeoperacijsko povraćanje kod djece nakon adenotonzilektomije.