Recovery and Vomiting after Pediatric Tonsillectomy with or without Adenoidectomy: Comparison between TIVA using Propofol and Thiopentone Induced Halothane Maintained Anesthesia

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ABSTRACT:

BACKGROUND:

Vomiting in the first few hours after recovery is considered as the main factor that delayed hospital discharge in pediatric outpatient surgery . Children having tonsillectomy with or without adenoidectomy operations have a high incidence of vomiting. Propofol has a short duration of action with rapid recovery and a proved antiemetic effect. Using propofol in total intravenous anesthesia, the incidence of vomiting is lower than the traditional thiopentone induced halothane maintained technique.

OBJECTIVE:

The aim of the study is to compare recovery characteristics and vomiting between total intravenous anesthesia using propofol as the sole anesthetic agent with the anesthetic technique using thiopentone for induction and halothane for maintenance to assess which is more suitable for outpatient pediatric surgery.

PATIENTS AND METHOD:

Forty healthy unpremedicated children, ASA I, aged 7-12 years undergoing tonsillectomy with or without adenoidectomy were randomly allocated into 2 groups. Group (1) children were induced with 2-3 $mg.kg^{-1}$ propofol while group (2) children were induce with thiopentone 5-6 $mg.kg^{-1}$. Maintenance was 0.2 $mg.kg^{-1}$ propofol in group (1) and 0.8% halothane in group (2). Both groups received 0.5$mg.kg^{-1}$ atracurium to facilitate intubation and maintain muscle relaxation. Oxygen 100% was administered to both groups. Other treatment and procedures were standardized intra and postoperatively . Extubation time, time for spontaneous eye opening and the state of recovery after thirty minutes were compared. Results of postoperative vomiting were analyzed in the first 6 hours and beyond that.

RESULTS:

Extubation time in group (1) was 4.75 ± 0.89 minutes and in group (2) it was 8.87 ± 1.86 minutes. The time for spontaneous eye opening in group (1) was 5.5 ± 1.22 minutes and in group (2) it was 13.125 ± 1.69 minutes. Both were significantly different . Nevertheless, both groups had a comparable modified Aldrete score which consists of 10 points and a score of 8-10 is considered ready to discharge to the general care unit. All patients in group (1) had a score of 10, while 1 patient had a score of 10, 14 patients with 9 and 5 patients with 8 in group (2). The incidence of vomiting in the first 6 hours after recovery was significantly lower in group (1) as well as the incidence after 6 hours. The same is applied to the incidence of recurrent vomiting (> 1 attack) in the first 6 hours, while recurrent vomiting after 6 hours were comparable in both groups. The overall incidence of recurrent vomiting was 35% in group (2) and 0% in group (1).

CONCLUSION:

Despite a comparable recovery, propofol has a lower incidence of vomiting after tonsillectomy with or without adenoidectomy in healthy children than thiopentone induced halothane maintained anesthesia and is more suitable for outpatient pediatric surgery.

KEY WORDS: Total intravenous anesthesia, thiopentone induced halothane maintained anesthesia, tonsillectomy with or without adenoidectomy, postoperative vomiting.

INTRODUCTION:

The trend in anesthesia today in general is to administer drugs that allow rapid and smooth induction, adequate and safe maintenance of

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anesthesia and should have high clearance with short duration of action so that recovery from drug effects will occur shortly after those effects are no longer needed by the patient and drug administration is stopped and preferably the recovery is pleasant and symptom free [1], while the trend in outpatient pediatric surgery is to discharge children to home within 6 hours [2] . These criteria are met by propofol[3].

Propofol has gained widespread popularity as an induction agent because of the ease and reliability of its use together with its short duration of action and minimal hangover effects[4] . Propofol infusion has been used in children having general surgery and has been shown to provide anesthesia with good operating conditions and a rapid recovery [5]. Rapid awakening from anesthesia is due to its rapid redistribution into the peripheral tissues and high clearance rate [3]. It has rapid onset of action with loss of consciousness in 11-15 seconds [6]. Side effects like cough, hiccough or muscle movement are comparable to those with thiopentone [7]. A single induction dose of 2-3 mg.kg $^{-1}$ is effective for 3-5 minutes with recovery that is faster than thiopentone 5mg.kg $^{-1}$[8] .

The antiemetic effect of propofol is well documented [9]. Bhakta et al. [10]reported that the incidence of PONV decreased by 30% in a group in which anesthesia was induced with propofol as than when it was induced with thiopental sodium in outpatients who underwent gynecologal laparoscopy. The duration of its antiemetic effect is still conflicting. Arslen et al.[11] found that the antiemetic effect of propofol was short-lived; reducing vomiting in the hospital but not after discharge . However, the mechanisms, the effective dose and the duration of the antiemetic effect of propofol remain unknown [12].

The reported incidence of postoperative vomiting after tonsillectomy and adenoidectomy procedures in children ranges from 63-73% when no prophylactic antiemetic is given [13] ,and may be as low as 23% when antiemetic is given[14]. The cause is unclear and probably is multifactorial in origin. Long duration of anesthesia and use of desflurane were identified as risk factors, in addition to risk factors of Apfel's score (female, non-smoker, history of motion sickness or PONV)[15].

Pharyngeal and laryngeal airway reflexes and swallowed blood are strong emetic stimuli. In addition, pain, anxiety, hypotension, hypoxemia, gastric distension, intraoperative anesthetic methods and drugs and the use of premedications and preoperative narcotics have all been implicated in postoperative vomiting and timing of oral food intake [16].

Hypotension, a well known cause of postoperative vomiting is more marked with propofol than thiopentone [17] .Nevertheless, propofol blunts the response to laryngoscopy and intubation more effectively than thiopentone or etomidate do [18] , as these reflexes contribute to vomiting. It has 60% incidence of pain on injection into the small veins on the back of the hand with standard propofol alone—that is, without any preventive measures [19] , and though pain is associated with vomiting, venous thrombosis and phlebitis are similar to those with most of the aqueous solutions [20].

Postoperative nausea and vomiting (PONV) may be mild and causes little discomfort, but severe vomiting is also a major cause of pediatric death because it can cause bleeding, dehydration, wound dehiscence, and aspiration pneumonia [21]. It is is a major factor that limits hospital discharge .Even mild PONV may result in a delayed hospital discharge, and , at times, results in unanticipated overnight admission in this population. with increased costs, as well as decreased parental satisfaction and an unpleasant experience for the patient , in addition to the increased incidence of postoperative discomfort [21]. Other factors associated with delayed discharge after tonsillectomy and adenoidectomy procedures include prolonged recovery, primary hemorrhage, airway obstruction, and poor oral intake that requires aggressive nursing care [21].

Several studies have variable incidence of vomiting after pediatric outpatient surgery when propofol anesthesia is compared with inhalation anesthesia. Factors that account for this difference include the type of surgery, use of nitrous oxide and opiates .

In this study, two anesthetic techniques, total intravenous anesthesia using propofol and thiopentone induce halothane maintained technique were compared for postoperative vomiting and recovery after tonsillectomy with or without adenoidectomy procedures in children.

PATIENTS AND METHODS:

This study was performed at the Anesthesiology Department in the Medical City in Baghdad and written parental informed consent was obtained.

This study included 40 children with no medical problems, aged 7-12 years, undergoing tonsillectomy with or without adenoidectomy . Apart from cardiovascular, respiratory, metabolic and central nervous system diseases, other factors that excluded enrollment in the study were bleeding tendency, history of allergy or previous

serious adverse experience with anesthesia, and anticipated airway difficulty.

All children were unpremedicated and they were all fasting for 6 hours preoperatively. Age, weight and sex of each child and type of surgery (i.e., tonsillectomy with or without adenoidectomy) were recorded . All children received 100% oxygen via facemask before induction of anesthesia and all were monitored by pulse oximetry, inhaled and exhaled halothane concentrations, electrocardiography and noninvasive arterial blood pressure. . The propofol group had cannulae placed at antecubital fossa vein to decrease the risk of pain during injection. All children received 2 $\mu g.kg^{-1}$ fentanyl iv just before induction and 20 $\mu g.kg^{-1}$ iv atropine as a drying agent and to prevent bradycardia.

According to the anesthetic technique, the children studied were randomly assigned into two groups:

Group 0 : Anesthesia induced with propofol 2-3 $mg.kg^{-1}$ iv and maintained with propofol $0.2mg.kg^{-1}.min.^{-1}$ iv infusion.

Group 1 : Anesthesia induced with thiopentone 5-6 $mg.kg^{-1}$ iv and maintained with halothane 0.8%.

Atracurium 0.5 $mg.kg^{-1}$ iv was given to facilitate intubation and to maintain muscle relaxation. All children were maintained on controlled ventilation and were received 100% oxygen. The size of endotracheal tube used was depending on a formula based on age: 4 + Age/4 = Tube diameter (in mm). In general the average size of the endotracheal tubes ranged from 4.5-6 mm. 1 ampoule of propofol was diluted with 50ml 5% dextrose water and was given via macrodrip to group (1) children, while group (2) children were maintained with halothane 0.8% .

Each child was given 120 ml dextrose saline solution for maintenance and deficit requirements. In addition, blood loss was replaced with 3 ml crystalloid solution for each ml of the lost blood. At the end of surgery (defined as removal of the mouth gag by the surgeon), the anesthetics were turned off and neuromuscular blockade was reversed with $0.05mg.kg^{-1}$ IV neostigmine and 0.02 $mg.kg^{-1}$ IV atropine.

The surgical time was measured from surgical incision to the removal of the mouth gag by the surgeon. The trachea was extubated in the operating room when the criteria of extubation were met . Extubation time (from the end of anesthesia until tracheal extubation) and spontaneous eye opening time (from the end of anesthesia until spontaneous eye opening) were measured. Postoperative recovery events documented at specific intervals and these include the immediate recovery criteria (extubation time and time for spontaneous eye opening), the modified Aldrete score after 30 minutes from the end of surgery, the number and frequency of emetic episodes, oral intake and complications such as airway obstruction and primary hemorrhage.

The modified Aldrete score consists of criteria that are used to determine patient' s readiness for discharge to the general care unit . A score of 8-10 is considered to be ready for discharge.

All children received oral antibiotics and oral analgesics postoperatively in standardized doses when they started to regain consciousness, that is about 2 hours postoperatively. No prophylactic antiemetics given. Children were not allowed to have a semi-solid food during the first 24 hours and to start with clear cold fluid at least 2 hours after reaching the ward.

The children were monitored for 24 hours in the general ward. The number and frequency of emetic episodes were observed. These episodes were recorded in the first 6 hours and thereafter. Repeated vomiting was treated with 0.15 $mg.kg^{-1}$ metoclopramide iv. The volume of fluid therapy was adjusted postoperatively, depending on blood loss, postoperative vomiting and oral intake

STATISTICS AND RESULTS:

Standard statistical tests were used to assess the results (t-test and chi-square test). A p value of equal or less than 0.05 was considered statistically significant.

Group (1) and group (2) were comparable for age, weight, sex and type of surgical procedure. Mean age in group (1) was 8.4 ± 1.8 and in group (2) was 9.2 ± 1.6. Mean weight in group (1) was 28.75 ±4.33 kg and in group (2) it was 30.5 ± 3.2 kg (table1). The induction doses of both groups and maintenance dose and the total dose of propofol are tabulated in table(2). The mean loading dose of propofol was 2.6 ± 0.3 mg and that of thiopentone was 5.8 ± 0.3 mg. The mean surgery time in both groups were not significantly different, for group(1) it was 36.6 ± 3.97 minutes, while in group (2) it was 38.8 ± 3.84 minutes. However, spontaneous eye opening and extubation times were statistically significant among the two groups. The mean spontaneous eye opening time in group(1) was 5.5 ± 1.22 minutes and in group (2) was 13.125 ± 1.69

minutes and the mean extubation time in group(1) was 4.75 ± 0.89 minutes and in group(2) it was 8.87 ± 1.86 minutes (Table 3).
These results show that propofol has a statistically lower time for spontaneous eye opening and extubation time than the thiopentone/halothane technique. Nevertheless, both techniques had a comparable modified Aldrete score. In group(1), 20 patients had a score of 10.In group (2), 1 patient had a score of 10, 14 patients had a score of 9 and 5 patients had a score of 8. So, both groups are considered to have a comparable early recovery despite the difference in the spontaneous eye opening and extubation times (Table 4).

Table 1: Demographic data.

Parameters	Group1	Group2	P value
-Number	20	20	
-Age	8.4 ± 1.8	9.2 ± 1.6	> 0.05
-Weight	28.75 ± 4.33	30.5 ± 3.2	> 0.05
-Sex (M/F)	14/6	13/7	
-Tonsillectomy	8	6	
-Tonsillectomy and adenoidectomy	12	14	

Table 2: Induction , maintenance and total doses.

Parameters	Group1	Group2
Induction ($mg.kg^{-1)}$	2.6 ± 0.3	5.8 ± 0.3
Maintenance ($mg.kg^{-1}min^{-1}$)	0.2	_
Total dose ($mg.kg^{-1}$)	9.67 ± 3.2	_

Table 3:Times for surgery, extubation and spontaneous eye opening.

Parameter	Group1	Group2	P value
Surgery time (minutes)	36.6 ± 3.97	38.8 ± 3.84	< 0.05
Extubation time(minutes)	4.75 ± 0.89	8.87 ± 1.86	< 0.05
Eye opening time(minutes)	5.5 ± 1.22	13.125 ± 1.69	< 0.05

Table 4: Results of the modified Aldrete score.

Group	Number	Score
1	20 (100%)	10
2	1 (5%)	10
	14 (70%)	9
	5 (25%)	8

The incidence of vomiting ≤6 hours after recovery was significantly different among the 2 groups ($p < 0.05$) as was vomiting after 6 hours. The incidence of vomiting ≤ 6hours was 10% in group (1) and 35% in group (2), while the incidence of vomiting ≥ 6 hours was 10% in group (1) and 30% in group (2). Total vomiting was also significantly different, with incidence of 20% in group (1) and 65% in group (2). Vomiting occurred 3.25 times as often among children in the thiopentone/halothane group than among those in the propofol group (Table 5).
The incidence of recurrent vomiting (defined as more than 1 attack) in group (2) was 20% within the first 6 hours after recovery and 15% afterwards, while no child had recurrent vomiting in the propofol group. The overall incidence of recurrent vomiting was 35% in group (2) and 0% in group (1). No airway complications that required emergent endotracheal intubation were noted among both groups postoperatively .

Table 5: The incidence of postoperative vomiting for 24 hours postoperatively.

Vomiting	Group1	Gtoup2	P value
One Attack			
< 6 hours	2 (10%)	7(35%)	< 0.05*
≥ 6 hours	2 (10%)	6(30%)	< 0.05
Total	4 (20%)	13(65%)	< 0.05
Recurrent (> 1 attack)			
< 6 hours	0	4(20%)	< 0.05
≥ 6 hours	0	3(15%)	> 0.05
Total	0	7(35%)	< 0.05

DISCUSSION:

In this study recovery parameters (spontaneous eye opening, extubation time, readiness for transfer to the recovery ward) were assessed in both groups. The immediate recovery scores (extubation time and spontaneous eye opening) were significantly better for propofol than thiopentone/halothane technique. Similar results were found by other investigators . Khalid et al [22] found that recovery was much faster with earlier gain of orientation with propofol anesthesia compared to isoflurane in the early recovery periods in patients with laparoscopic cholecystectomy. Ohkushi et al [23] found similar results when compared propofol and inhalation anesthesia for dental surgery.

Despite these results, the modified Aldrete score was comparable among the 2 groups. That is to say, though the immediate recovery scores were significantly different, both groups had a comparable recovery and the children in both groups were ready to discharge to the general care unit in approximate time. This is in contrast with other studies which found that the modified Aldrete score was significantly better with propofol than thiopentone. Manjula et al [24] Compared thiopentone sodium and propofol as anesthetic agents for modified electroconvulsive therapy and found that propofol had a better recovery characteristics than thiopentone based on Aldrete score . This difference in the modified Aldrete score may be explained by the short overall duration of anesthesia of this study in comparison from the above mentioned studies. Had this study been carried out on patients having surgery of longer duration, one might have expected to see a significantly shorter recovery time in the propofol infusion group . This goes in line with similar studies of Gauthier et al [25] where time to recovery was found to increase with increasing duration of isoflurane anaesthesia or other anesthetics but not after propofol anaesthesia.

The reported incidence of vomiting in pediatric tonsillectomy in general remains 40-70% which is comparable to this study. McGrath et al. found that the main factor that delayed hospital discharge in pediatric outpatient surgery was vomiting in the first few hours [26]. They related this to mandatory oral intake rather than to the anesthetic technique. In their opinion, mandatory oral intake could also account for the lack of variation in the discharge time among the different groups.

Because the trend today in outpatient pediatric surgery is to discharge children to home within 6 hours and discharge time beyond 6 hours would be considered for an unplanned overnight hospital admission in an observation unit, the results of vomiting and recovery were analyzed in the first 6 hours and beyond 6 hours for 24 hours. The cause behind this trend is that most surgeon and anesthetists favor this minimum postoperative stay to detect early bleeding, poor oral intake and recurrent vomiting .

Nausea is difficult to assess in children in this age group . Therefore, and unlike adult population, only vomiting was allocated to compare between the two techniques of anesthesia without referring to nausea or retching. Accordingly , we used the term POV (postoperative vomiting) instead of the term PONV (postoperative nausea and vomiting) which only relates to vomiting and omits nausea and retching.

Narcotics are routinely used in anesthesia to inhibit pain. Both pain and narcotics are strong emetic stimulants. Some studies found that, despite anesthetic maintenance with propofol, the risk of vomiting was increased when intraoperative narcotics were used [27].

To control these factors, all children in this study received analgesics in standardized doses and premedications including antiemetics were not given. Therefore, the choice of narcotics used in

this study could not account for the increased vomiting when halothane was used for maintenance of anesthesia.

Interpratation of the data revealed that propofol group had significant difference in the incidence of vomiting within the first 6 hours and beyond 6 hours postoperatively. The same is applicable for the recurrent vomiting (more than one attack of vomiting) . There was no statistical difference in the incidence of recurrent vomiting postoperatively, However, the overall incidence of vomiting was statistically different. According to Arslan et al. [11], the incidence of POV was relatively lower in the first six hours in patients for whom anesthesia was induced with propofol compared to halothane in patients undergoing middle ear surgery , but thereafter no significant difference was observed. Also Kumar et al [28] found that TIVA with propofol, rather than inhalation anesthesia, may have a clinically relevant effect on PONV but only in the short term in patients with ambulatory surgery.

Apfel et al. reported that volatile anesthetics were the leading cause of early POV [15]. Compared with sevoflurane or desflurane , total intravenous anesthesia (TIVA) with propofol and remifentanil resulted in a significantly lower incidence of PONV[28]. As vomiting is a major factor that limits hospital discharge in pediatric surgery, this would be considered as an important advantage for the total intravenous anesthesia with propofol over the thiopentone/ halothane technique. According to Simurina et al. [29] no significant difference was observed in the incidence of POV between a group of children who underwent an adenotonsillectomy, in which anesthesia was induced with propofol-fentanyl and then maintained, and that done using sevoflurane. As described here, controversial opinions still exist regarding the effects of TIVA for preventing PONV in children.

In this study children were not allowed to have elective oral intake. This may be responsible for the difference in the results of postoperative vomiting from the above mentioned studies as those studies relate the lack of variation in the incidence of postoperative vomiting between the total intravenous anesthesia with propofol and the thiopentone/halothane technique to mandatory oral intake. The overall incidence of vomiting in those studies was lower than in this study, and this may be due to the fact that those researchers were using antiemetics in their studies including metoclopramide and dexamethasone.

CONCLUSION:

In conclusion, despite a comparable recovery, propofol as a sole anesthetic agent for pediatric tonsillectomy with or without adenoidectomy has a lower incidence of vomiting than the technique using thiopentone for induction and halothane for maintenance and is more suitable for pediatric outpatient tonsillectomy operations.

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