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The Effect of Dexamethasone on Postoperative Vomiting After Tonsillectomy

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In this double-blinded, randomized, placebo-controlled study, we assessed the effect of dexamethasone 0.5 mg/kg IV administered preoperatively in 110 children 2–12 yr old, undergoing electrodissection adenotonsillectomy, using a standardized anesthetic technique. The incidence of early and late vomiting, the time to first oral intake, the quality of oral intake, the satisfaction scores, and the duration of IV hydration were compared in both groups. The overall incidence of vomiting, as well as the incidence of late vomiting, was significantly less in the Dexamethasone group as compared with the Saline group (23% and 19% vs 51% and 34%, respectively). The time to first oral intake and the duration of IV hydration were shorter in the Dexamethasone group compared with the Saline group ($P < 0.05$). The quality of oral intake and the satisfaction scores were better in the Dexamethasone group than in the Saline group ($P < 0.05$). This report confirms the beneficial effect of IV dexamethasone on both vomiting and oral intake in children undergoing electrodissection adenotonsillectomy.

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The incidence of postoperative emesis is more frequent in pediatric patients than in adults (1). Within the pediatric population, postoperative emesis increases with age to reach a peak incidence in the preadolescent 11–14-yr age group (2). Also, postoperative vomiting depends on the type of surgery; the incidence is increased after strabismus, tonsillectomy or orchiopexy than it is after extremity or orthopedic surgery (3). Tonsillectomy with or without adenoidectomy is one of the most frequently performed surgical operations in children and is associated with an incidence of postoperative vomiting ranging between 40% and 73% (4–6). Thus, prophylactic antiemetic therapy is indicated in this high-risk group of children.

Dexamethasone was first reported to be an effective antiemetic drug in patients receiving cancer chemotherapy (7). Recently, dexamethasone has been found to have a prophylactic effect on postoperative vomiting in adults undergoing laparoscopic and gynecological surgery (8–10) and in children undergoing tonsillectomy and strabismus surgery (11–14). Dexamethasone lacks side effects when used as a single injection and has a low cost and a prolonged biological half-life of 36 to 48 h (15). Also, it has combined antiemetic and antiinflammatory effects that may decrease postoperative edema and subsequently may improve oral intake after tonsillectomy. However, many reports have questioned the efficacy of dexamethasone as an antiemetic as well as its beneficial effect on the quality of oral intake after tonsillectomy (16–18). This controversy may be attributed to the wide range of dosage of dexamethasone as well as the wide variety of anesthetic techniques used.

We investigated the efficacy of a single dose of dexamethasone 0.5 mg/kg IV on postoperative vomiting and oral intake in a group of children undergoing tonsillectomy using a standardized anesthetic technique and dose. The results were compared with those achieved in a control group of children undergoing tonsillectomy by using a similar technique of anesthesia but without the preoperative administration of dexamethasone.

Methods

After approval from the institution's ethical committee and informed consent from the parents, 110 patients, 2–12 yr old, ASA physical status I or II, undergoing tonsillectomy with or without adenoidectomy, were enrolled in the study.

The study design was randomized, double-blinded, and placebo-controlled. Children who received antiemetics, steroids, antihistaminics, or psychoactive

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drugs within 24 h before surgery were excluded from the study. Also, children in whom IV induction was indicated or steroid administration was contraindicated were excluded.

All children did not ingest solid food on the day of surgery, but were permitted to drink clear fluids for up to 3 h before the administration of anesthesia. Premedication was administered 30 min before the anticipated induction and consisted of midazolam 0.5 mg/kg by mouth (maximum dose, 15 mg) and atropine 0.02 mg/kg IM (maximum dose, 0.5 mg). After standard patient monitoring was established, an inhaled induction was performed by using N_2O and sevoflurane, followed by the insertion of an IV cannula. Endotracheal intubation was facilitated by rocuronium 0.6 mg/kg. Anesthesia was maintained with 70% N_2O and 2%–4% sevoflurane. All children received fentanyl 1 μg/kg before surgery started and 20–30 mL/kg lactated Ringer's solution during the intraoperative period. Patients were randomized to receive either dexamethasone 0.5 mg/kg IV (maximum dose, 8 mg) or an equivalent volume of saline. The study drugs, prepared by the pharmacy, were administered after the induction of anesthesia and before surgery, in a double-blinded fashion. An attending surgeon using an electrodissection technique performed the surgical procedure. At the end of the surgery, the gastric contents of all children were suctioned via an orogastric tube and received propacetamol 30 mg/kg IV for postoperative pain relief. Residual neuromuscular blockade was reversed with neostigmine 0.05 mg/kg and atropine 0.02 mg/kg before extubation. All children were transferred to the postanesthesia care unit (PACU) where standard monitoring was established, and they were observed for 2 h. The incidence of vomiting was recorded by the PACU nurse. Water was offered to the children in the PACU on request. After transfer to the floor, a soft diet was offered to all children during their hospital stay. Also, a maintenance IV infusion was kept until their oral intake was judged adequate (ingestion of 150 mL of fluids and 150 mL of soft food within 6 h). The time of the removal of the IV line was recorded. Rectal paracetamol 30 mg/kg was administered to all children every 6 h. At 24 h, and before discharge from the hospital, the parent or the child (if age $>$ 7 yr) reported to one of the investigators the following information that he/she was instructed to observe: the total number and the time of vomiting episodes; the time to first oral intake; the quality of oral intake assessed by the following scale: 1 = child requests food, 2 = child accepts it when offered, 3 = child accepts it when coaxed, 4 = child refuses it (11); and the satisfaction score rated as excellent, good, fair, or poor. Episodes of vomiting occurring $<$5 min apart were considered one episode. Nausea was not recorded because it is difficult to assess in children. Vomiting was treated with metoclopramide 0.15 mg/kg IV when it occurred more than twice. Early vomiting was defined as vomiting in the PACU, and late vomiting was defined as vomiting on the floor.

Table 1. Demographic Data and Duration of Anesthesia and Surgery

	Dexamethasone group $n = 53$	Saline group $n = 53$
Age (yr)	5.1 ± 2.2	4.6 ± 2.0
Weight (kg)	20.0 ± 6.9	19.4 ± 5.9
Sex (male/female)	71/29	55/45
Anesthesia duration (min)	50.1 ± 14.7	49.7 ± 12.8
Surgery duration (min)	34.5 ± 13.3	32.6 ± 11.9

All values are expressed as mean ± SD, except sex, which is expressed as %.

After a pilot study, a 50% incidence of emesis after tonsillectomy was observed and used in determining the power of the study. A 50% reduction in the incidence rate was considered clinically significant. With α considered at 5% and β at 20%, the number of patients enrolled was estimated to be 55 in each group. Data were compared by using the Student's *t*-tests, Mann-Whitney *U*-test, the χ^2 test, and logistic regression analysis, whichever was appropriate. Statistical significance was achieved when P was <0.05.

Results

Of the 110 children enrolled, 4 were excluded from the study because of protocol violation (administration of IV propofol for the induction of anesthesia). Of the remaining 106 children, 53 received a dexamethasone and 53 received a saline injection. The demographic data of the patients and the duration of surgery and anesthesia were not significantly different between the two groups (Table 1).

No difference in the number of patients who requested water in the PACU was noted between the two groups (Table 2). Also, the incidence of postoperative vomiting was not significantly different between the two groups before PACU discharge (19% in the Dexamethasone group versus 34% in the Saline group, $P = 0.09$). However, the incidence of late vomiting, as well as the overall incidence of vomiting during both PACU and floor stay, was significantly more frequent in the Saline group (10% versus 39%, $P = 0.001$ for late vomiting and 23% versus 51%, $P = 0.004$ for the overall incidence of vomiting) (Table 2). Five patients in the Saline group vomited more than 2 times with a maximum of 11 episodes in one of these patients, while only one patient in the Dexamethasone group vomited more than 2 times. The median vomiting episodes per patient who vomited was 1 (range, 1–3) in the Dexamethasone group as compared with 2

Table 2. Recovery Characteristics During the First Twenty-four Hours

	Dexamethasone group $n = 53$	Saline group $n = 53$	P
Water request in PACU (%)	56	50	0.5
Vomiting in PACU (%)	19	34	0.09
Vomiting on floor (%)	10	39	0.001
Total of patients who vomited (%)	23	51	0.004
Vomiting episodes per patient who vomited (median and range)	1(1–3)	2(1–11)	0.17
Time to first oral intake (hr) (mean ± SD)	5.38 ± 3.3	10.9 ± 8.1	0.001
Quality oral intake (%)[a]	67	23	0.001
Outcome, excellent + good (%)	84	43	0.001
Duration of IV hydration (hr) (mean ±SD)	11.5 ± 5.4	17.7 ± 8.2	0.001

PACU = postanesthesia care unit.
[a] Child requests food and child accepts food when it is offered.

(range, 1–11) in the Saline group ($P = 0.17$). The time to the first oral intake was significantly shorter, and the quality of intake was significantly better in the Dexamethasone group ($P = 0.001$ and 0.001, respectively). Also, the satisfaction score was significantly higher in the Dexamethasone group as compared with the Saline group ($P = 0.001$) (Table 2). The duration of IV hydration was 11.5 ± 5.4 h in the Dexamethasone group versus 17.7 ± 8.2 h in the Saline group ($P = 0.001$). Two patients in the Saline group and none in the Dexamethasone group had a delayed discharge from the hospital (more than a 24-h stay) because of poor oral intake. By logistic regression analysis, age was not identified as a significant predictor of postoperative vomiting (odds ratio = 1.05, $P = 0.82$).

Discussion

Postoperative morbidity after tonsillectomy in children includes pain, inadequate oral intake, vomiting, dehydration, fever, and bleeding. An electrodissection technique has been used because it reduces operative time and it virtually eliminates immediate postoperative hemorrhage (19,20). However, electrodissection may cause more pain and discomfort postoperatively as a result of more inflammation, edema, nerve irritation, and spasm of exposed laryngeal muscle (19,20). Corticosteroids decrease local inflammation by blocking the chemical mediators of inflammation. Dexamethasone exerts an antiemetic action via prostaglandin antagonism, release of endorphins, and tryptophan depletion (21–24). However, it is not clear whether in this procedure dexamethasone exerts its effect by a central or peripheral mechanism. These therapeutic effects have led to the widespread use of dexamethasone in children undergoing tonsillectomy.

April *et al.* (12) found that treatment with IV dexamethasone (1 mg/kg up to 16 mg) in children before electrocautery tonsillectomy and adenoidectomy decreases morbidity and increases early postoperative oral intake. Pappas *et al.* (11) observed a decrease in the overall incidence of postoperative vomiting, especially during the 24 hours after discharge, as well as an improvement in the postoperative quality of oral intake in children undergoing tonsillectomy who received dexamethasone 1 mg/kg after the induction of anesthesia as compared with those in a control group. No difference was observed between the two groups in the incidence of early vomiting. Splinter and Roberts (13) found that dexamethasone 150 μg/kg IV up to a maximum dose of 8 mg administered before tonsillectomy markedly decreased vomiting by children both during early recovery (PACU) and late recovery (24 h). In this study, more patients in the Dexamethasone group received propofol induction, which may have reduced the incidence of early vomiting.

Several published studies failed to demonstrate any beneficial effect of dexamethasone on the incidence of postoperative vomiting or the degree of pain after tonsillectomy in children (16–18). These studies included a limited number of children and were not standardized for both the anesthetic technique and other perioperative factors. One of these studies, by Ohlms *et al.* (16), showed that the use of dexamethasone 0.5 mg/kg versus placebo at the start of operation had no effect on postoperative pain in the hospital or at home. Also, no measurable effect was seen on the time to first oral intake, the type of diet, emesis, the presence of halitosis or fever, the use of pain medication, or the level of activity; the lack of beneficial effect in these children may be attributed to the use of droperidol (0.025 mg/kg) in both the Dexamethasone and the Placebo groups, and to the use of the sharp dissection–snare technique associated with less postoperative pain.

In our study, we administered dexamethasone 0.5 mg/kg IV or saline, immediately after the induction of anesthesia, in children undergoing electrodissection tonsillectomy. Unlike the previous studies, the number of children investigated in the present report was increased. The anesthetic protocol was standardized and did not include any other

prophylactic antiemetic drug. The incidence of vomiting in our patients in the PACU was more frequent in the Saline group versus the Dexamethasone group. This difference did not reach significance, however the associated *P* value of 0.09 shows a clear trend toward a better control of vomiting in the Dexamethasone group in the PACU. In a larger number of observations, it could be that the effect of dexamethasone to decrease vomiting in the PACU would be statistically significant. The incidence of vomiting was significantly decreased in the Dexamethasone group compared with the Saline group. Dexamethasone modulates inducible COX-2 (25). The decrease in vomiting in the treatment group might also be attributed to potentiation of the effect of the analgesic combination used. Also, the late efficacy of dexamethasone is consistent with its biological half-life of 36 to 48 hours (15).

Age is identified as a cofactor for increasing the incidence of postoperative vomiting with a peak incidence at the preadolescent age (2). A logistic regression failed to demonstrate any correlation between age and the incidence of postoperative nausea and vomiting in our study. This may be because the age of the children in our report occurred within a narrow range.

The time to first oral intake and the duration of IV hydration were shorter in the Dexamethasone group as compared with the Saline group. The quality of oral intake and the satisfaction scores were better in the Dexamethasone group versus the Saline group. These results may be attributed to the antiinflammatory effect produced by corticosteroids, which may reduce edema and pain (26).

Complications from corticosteroids therapy, such as an increased rate of infection, peptic ulceration, and adrenal suppression, are usually related to its long term use. The risks of steroid therapy of $<$24 hours are negligible (27).

Fisher (28) in his editorial in *Anesthesiology* questioned whether counting the number of episodes of vomiting or the number of patients with no episodes of vomiting were valid endpoints, claiming that they were surrogates for the true outcomes. The relationship to more meaningful outcomes, such as patient satisfaction, should be considered carefully. Any therapy, including antiemetics, may induce adverse events that mitigate against the positive effects of therapy (29). In our study, the single use of dexamethasone resulted in a decrease in the incidence of vomiting (surrogate outcomes). Also, the better quality of oral intake and satisfaction scores as well as the lack of side effects associated with dexamethasone suggest a significant improvement in the true outcomes in the Dexamethasone group.

In conclusion, our results showed that the use of dexamethasone 0.5 mg/kg IV up to 8 mg after the induction of anesthesia in children undergoing electrodissection tonsillectomy with or without adenoidectomy significantly decreases the incidence of postoperative vomiting, mainly after discharge from the PACU. Also, it improves the quality of oral intake and satisfaction scores, shortens the time to first oral intake, and decreases the duration of IV hydration. Further investigation of dexamethasone should include a dose-response study.

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