

The Hemostatic Efficacy of Hydrogen Peroxide Irrigation to Control Intraoperative Bleeding in Adenoidectomy

Original Investigation

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Abstract

Objective: Although adenoidectomy is generally accepted as a safe procedure, intraoperative hemorrhage is still the most common and potentially life-threatening complication, especially in pediatric patients. We evaluated the clinical effect of intraoperative hydrogen peroxide irrigation with respect to hemostasis and operation times in pediatric adenoidectomy.

Methods: This was a prospective, randomized, double-blind study to investigate hydrogen peroxide solution in hemostasis in pediatric patients undergoing adenoidectomy. The patient, the surgeon, and the study nurse were blinded to the surgical technique used.

Results: One hundred seventeen (56 males and 61 females) consecutive pediatric patients with a mean age of 5.46 ± 1.19 years were included in the study. There were 58 patients in the hydrogen peroxide group (median age: 6 years, mean age: 5.62 ± 1.28 ye-

ars) and 59 patients in the control group (median age: 5 years, mean age: 5.31 ± 1.07 years). No significant difference was observed between the two groups with respect to age ($p=0.151$), gender ($p=0.646$), or adenoid size ($p=0.767$). On the other hand, the difference between the groups with respect to operation and hemostasis times was found to be statistically significant ($p<0.001$ for both). The average operation times were 8.67 ± 0.48 min in the hydrogen peroxide group and 12.30 ± 0.69 min in the control group. The average hemostasis times were 3.67 ± 0.27 min in the hydrogen peroxide group and 5.73 ± 0.31 min in the control group.

Conclusion: Hydrogen peroxide solution can be effectively used in adenoidectomy for reducing intraoperative blood loss and for economic benefits.

Keywords: Adenoidectomy, hydrogen peroxide, hemorrhage, hemostasis, operative time



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Cite this article as: Altun H, Hancı D, Kumral TL, Uyar Y. The Hemostatic Efficacy of Hydrogen Peroxide Irrigation to Control Intraoperative Bleeding in Adenoidectomy. Turk Arch Otorhinolaryngol 2018; 56(4): 193-8.

Introduction

Adenoidectomy is among the most commonly performed otolaryngologic procedures in children (1-3). Removing adenoid tissue with a complex vascular anatomy requires general anesthesia, and early or delayed hemorrhage is generally the most observed complication of adenoidectomy (1, 4-6). Blood transfusion should be performed in children with a loss of 10% of the total blood volume to prevent life-threatening complications (4). Placing gauze packings in the nasopharynx and leaving it for a while is the most commonly used technique for hemostasis of intraoperative bleeding (7). If bleeding cannot be controlled by gauze packings, irrigation by saline, and packings with epinephrine, electrocautery can also be used (7). Intraoperative

blood loss can be avoided with constant monitoring during the procedure; however, postoperative blood loss is unpredictable (1). The incidence of primary (<24 h post-adenoidectomy) or secondary (usually 5–10 days post-adenoidectomy) postoperative bleeding is reported to be between 1% and 8% (2, 5, 8).

Hydrogen peroxide is well-known for its antimicrobial and antiseptic properties. It is used to clean surgical cuts for better localization of bleeding focus in surgery and orthopedics and burn excisions to induce hemostasis (9-11). Topical application of hydrogen peroxide was proven to induce hemostasis and reduce operative time in both tonsillectomy (12) and adenoidectomy (13). The aim of the present study was to evaluate the effect of intraopera-

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Received Date: 27.02.2018
Accepted Date: 13.08.2018

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 DOI: 10.5152/tao.2018.2003

tive application of hydrogen peroxide solution in hemostasis and operative times in pediatric adenoidectomy.

Methods

Study subjects

This prospective study was conducted at Yunus Emre Hospital, Istanbul, Turkey. Pediatric patients who underwent adenoidectomy between September 2014 and March 2015 were included in this prospective, randomized, double-blind study. Children <3 years old or >10 years old and with re-adenoidectomy and/or underlying chronic illness or bleeding disorder were excluded from the study. Written informed consent was obtained from the parents of a total of 117 pediatric patients prior to their inclusion in the study. The Local Ethics Committee of Bakırköy Sadi Konuk Training and Research Hospital (2015/05/10) approved the study in accordance with the Declaration of Helsinki.

Patients were randomized to the hydrogen peroxide or control groups by a computerized random number chart for each day of the study. A 3% hydrogen peroxide solution (Pozitif Kimya, İstanbul, Turkey) was freshly prepared by a 50% dilution with a physiological saline solution. Saline solution was directly used in patients in the control group. Hydrogen peroxide and saline solutions were used at 21°C. The patients, the study nurse, and the surgeon were not aware of the type of solution used for irrigation.

Surgical procedure

All adenoidectomy procedures were performed under general anesthesia. The same otolaryngologist performed all operations. The Rose position was performed in all patients. The neck was extended. The shoulder roll was used for every case. Traditional cold steel adenoidectomy was performed using a classic adenoid curette. For exclusion the presence of a submucosal cleft, palpation of the palate was performed. A Boyle-Davis gag was used. The Wormald and Prescott grading system (three levels) was used for measurement of adenoid size (14). The degree of choanal obstruction due to the adenoids was used in grading the cases. If less than one-third of the posterior choanae is obstructed, it is classified as grade 1. If one-third to two-thirds of the posterior choanae is obstructed, it is called as grade 2. For grade 3, it is necessary that the adenoids must obstruct more than two-thirds of the posterior choanae (14). To check the removal of the adenoids, digital palpation and mirror examination were performed. A tonsillar packing for 1 min was used for hemostasis. After this procedure, either hydrogen peroxide or physiological saline solution was transorally filled into the nasopharynx through the nose with the patient's neck extended to prevent losing the solution. The irrigation was completed after clearing of the washout fluid. Hemostasis was considered to be failed if bleeding persisted for >10 min, or 1 L of the irrigation solution was exceeded. In this case, the nasopharynx was controlled for the remaining adenoid tissue, and, if necessary, recurette and/or bipolar electrocauterization were performed. Patients were moved to

the postoperative care unit at the end of the surgery. They were transported to the in-patient clinic when they are stable. All of the patients were discharged on the same day of operation. The operative time was considered as the period between insertion and removal of the mouth gag. The hemostasis time was accepted as the period between the end of adenoidectomy and achievement of hemostasis.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) software package for Windows version 12.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Categorical variables were expressed as numbers and percentages. Quantitative variables were expressed as mean±standard deviation, median, and minimum and maximum values. Student's t-test was used for normal distribution of parametric variables. Chi-square or Fisher's exact test was used for non-normal distribution of non-parametric variables. A p-value<0.05 was considered as significant.

Results

A total of 117 consecutive pediatric patients were included in this prospective, double-blind, controlled clinical study on the hemostatic efficacy of hydrogen peroxide irrigation for bleeding control in the surgery of adenoid tissue. There were 56 (47.9%) males and 61 (52.1%) females with a mean age of 5.46±1.19 (3–9) years. The randomization was performed by randomized blocks; therefore, the distribution of the patients to the study groups was balanced with 58 patients in the hydrogen peroxide group and 59 patients in the control group. Table 1 shows the demographic characteristics, adenoid size, and indication for adenoid surgery of patients according to the study group they were assigned. In the hydrogen peroxide group, the youngest patient was 3 years old, and the oldest was 9 years old (median age: 6 years, mean age: 5.62±1.28 years), and 51.8% of the children were male. In the control group, the youngest child was 4 years old, and the oldest was 8 years old (median age: 5 years, mean age: 5.31±1.07 years), and 48.2% of the children were male. In terms of adenoid size, of the patients, 11 were grade 1 (19.0%), 31 were grade 2 (53.4%), and 16 were grade 3 (27.6%) in the hydrogen peroxide group, whereas 13 were grade 1 (22.0%), 33 were grade 2 (55.9%), and 13 were grade 3 (22.0%) in the control group. There were no differences in terms of age (p=0.151), gender (p=0.646), or adenoid size (p=0.767) between the groups (Table 1). Choanal obstruction was diagnosed in 47 (81.0%) patients in the hydrogen peroxide group and in 51 (86.4%) patients in the control group. Infection was detected in 11 (19.0%) patients in the hydrogen peroxide group and in 9 (15.3%) patients in the control group. There was no difference between the groups (p>0.05 for both, Table 1).

The average operative times were 8.67±0.48 (8.07–10.03) min in the hydrogen peroxide group and 12.30±0.69 (11.03–14.02) min in the control group. The average hemostasis times were 3.67±0.27 (3.25–4.24) min in the hydrogen peroxide group and 5.73±0.31 (5.23–6.25) min in the control group. The difference

between the groups with respect to operation and hemostasis times was found to be statistically significant ($p < 0.001$ for both, Table 2). The duration of follow-up time was 15 days. There was no hemorrhage in the control and study groups during this time.

No correlation was observed between the size of the adenoid tissue, indication for adenoid surgery, age of the patients, and hemostasis or operation time ($p > 0.05$). There was no statistically significant difference between the groups with respect to the need for recurettage and electrocauterization for hemostasis ($p = 0.717$, Table 2). There were no complications in both groups, including postoperative hemorrhage, blood transfusion, aspiration, or hospitalization.

Discussion

Adenoidectomy is the removal of the adenoid tissue causing impaired breathing through the nose, chronic infections, recurrent earaches, obstructive sleep apnea, failure to thrive, or abnormal dentofacial growth, speech impairment, and halitosis (3, 15, 16). Although usually recognized as a safe procedure, intraoperative or postoperative hemorrhage remains the most common and likely life-threatening complication in adenoidectomy due to aspiration risks, spasm of the larynx, and invisible swallowing of blood causing blood circulation collapse (5, 7, 16-18). The surgical removal of the adenoids with complex vascular anatomy is performed by sharp dissection which causes hemorrhage during surgery, where hemostasis can be established via postnasal packing or diathermy (7, 19). If bleeding is not controlled, urgent care is required, especially in children

where a blood transfusion is necessary when 10% of the total blood volume is lost (1, 4). The average intraoperative blood loss in adenoidectomy was considered to be 43 to 54 mL (4, 16). Although excessive hemorrhage is not common in adenoidectomy, the time period of hemostasis is essential to lower the blood loss and the duration of operation, which is directly impacted by hemostasis time.

A wide array of hemostatic agents have been studied for their effectiveness in reducing intra- or postoperative bleeding in adenotonsillectomy (6, 20, 21) and adenoidectomy alone. Floseal (22), topical use of adrenaline (23), hot saline solution (19), Ankaferd BloodStopper (7, 24), and topical use of tranexamic acid (5) are some examples of the positive effect of hemostatic agents on operation and hemostasis amount of time in adenoidectomy.

The hemostatic effect of Floseal in adenoidectomy was investigated in 70 children (22). Floseal applied as a gel to the operative site was proven to considerably reduce time of hemostasis and loss of blood during hemostasis. The mean hemostasis time and blood loss during hemostasis in the Floseal group were considered to be 0.6 min and 2.5 mL, respectively; and those of the cauterization group were 9.5 min and 29.4 mL, respectively. Teppo et al. (23) studied the effectiveness of topical use of racemic adrenaline in hemostasis during adenoidectomy in 93 children. The mean time period of operation in adenoidectomy was reported to be considerably reduced with the use of racemic adrenaline as a hemostatic agent, with 18 min in the placebo group and 13 min in the treatment group.

Table 1. Demographic and clinical characteristics of the patients

		Study patients (n=117)	Hydrogen peroxide group (n=58, 49.6%)	Control group (n=59, 50.4%)	p ^a
Age (year)		5.46±1.19	5.62±1.28	5.31±1.07	0.151
Gender	Male	56 (47.9%)	29 (51.8%)	27 (48.2%)	0.646
	Female	61 (52.1%)	29 (47.5%)	32 (52.5%)	
Adenoid grade	Grade 1	24 (20.5%)	11 (19.0%)	13 (22.0%)	0.767
	Grade 2	64 (54.7%)	31 (53.4%)	33 (55.9%)	
	Grade 3	29 (24.8%)	16 (27.6%)	13 (22.0%)	
Indication	Infection	19 (16.2%)	11 (19.0%)	8 (13.56%)	0.594
	Obstruction	98 (83.8%)	47 (81.0%)	51 (86.4%)	

^aChi-square test for categorical data and Student's t-test for continuous data

Table 2. Adenoidectomy data for the hydrogen peroxide and control groups

	Study patients (n=117)	Hydrogen peroxide group (n=58)	Control group (n=59)	p ^a
Operation time (min)	10.50±1.91	8.67±0.48	12.30±0.69	<0.001
Hemostasis time (min)	4.71±1.07	3.67±0.27	5.73±0.31	<0.001
Recurettage and/or bipolar electrocauterization	8 (6.8%)	3 (5.2%)	5 (8.5%)	0.717

^aChi-square test for categorical data and Student's t-test for continuous data

The efficiency of hot (50 °C) saline irrigation for hemostasis in adenoidectomy was evaluated by Ozmen and Ozmen (19) in 120 pediatric patients. The mean operation time was reported to be 12 min, and the use of hot saline solution decreased operative time by 3.1 min. Iynen et al. (7) studied the effect of the Ankaferd BloodStopper on 46 pediatric patients. The Ankaferd BloodStopper was reported to considerably decrease operation time from 13 min to 9 min. The same study indicated the significant effect of the Ankaferd BloodStopper in hemostasis time having a decrease from 5.8 min to 3.8 min. The hemostatic efficiency of the Ankaferd BloodStopper in adenoidectomy appeared to be proven with 20 mL average blood loss in the treatment group and 25 mL in the control group. The reduction in hemostasis time was further proven by Yasar and Ozkul (24).

Four hundred children were incorporated within the study investigating the result of the topical use of tranexamic acid in adenoidectomy as reported by Albirmawy et al. (5). The result of the topical use of tranexamic acid on operation and hemostasis time was not evaluated in their study; however, the level of blood loss during surgery and the frequency of primary post-adenoidectomy hemorrhage were significantly reduced in pediatric patients in the tranexamic acid group. Although effective in preventing excessive hemorrhage during adenoidectomy, there are some drawbacks of all hemostatic agents mentioned above. For example, Floseal, the most effective hemostatic agent reported to date, is costly for use in adenoidectomy. Saline irrigation can be used to control hemorrhage during adenoidectomy; however, as considered to be more effective in hemostasis, heating saline solution to 50 °C can be problematic during surgery, especially when a sudden care is needed to prevent excess blood loss.

Hydrogen peroxide is a clear and odor-free liquid used as a disinfectant owing to its antimicrobial properties (11). The surgical utilization of hydrogen peroxide is mainly for much better visualization of bleeding sources (9, 10). Regarding its hemostatic properties, hydrogen peroxide when sprayed to the bleeding area is reported to secure hemostasis in one-third of the patients in endoscopic gastroenterology (9, 25), and it is efficiently used as a hemostatic agent in arthroplasty in orthopedics (12). Its usefulness in securing rapid hemostasis in neurosurgery by packing with cotton balls drenched with 3% hydrogen peroxide and in securing hemostasis in tangentially excised wounds with topical application was proven (10). Chang et al. (13) performed a study in 120 pediatric patients to determine the hemostatic efficacy of the topical use of cold hydrogen peroxide in adenoidectomy. They reported a significant decrease in intraoperative time with cold hydrogen peroxide packing (approximately 10 min) in comparison with hydrogen peroxide packing in room temperature (15 min) or other hemostatic agents. They also found less incidence of oozing and active bleeding with the topical use of cold hydrogen peroxide. Topical use of hydrogen peroxide seemed to be reported to significantly reduce operative time and intraoperative blood loss by 31% and 33%, respectively, in tonsillectomy (12).

Ugur et al. (26) studied the effectiveness of a 0.5% hydrogen peroxide irrigation to control bleeding after adenoidectomy. They reported that there are no statistical reductions in hemostasis or operative time in the 0.5% hydrogen peroxide group, although the average hemostasis time of the hydrogen peroxide group was shorter than that of the control group (26). In the literature, there are some cases that injudicious use of over-the-counter 3% hydrogen peroxide can result in a chemical burn to the oral mucosa (27). For these reasons, it is appropriate that products containing moderate concentrations of hydrogen peroxide (>5%) carry warnings relating to avoiding both ingestion and contact of hydrogen peroxide solutions with the skin or mucosal surfaces. The hazard rating for contact with 3% hydrogen peroxide is rated as slight, whereas that for 30% hydrogen peroxide is rated as extreme because of the corrosive nature of strong hydrogen peroxide solutions (28).

In our study, hydrogen peroxide (3%) solution was freshly prepared by a 50% dilution with a physiological saline solution. We have not seen any burn in the oral mucosa or esophagus. During surgery, administrated hydrogen peroxide was aspirated intraorally. Topical use of a hemostatic agent is, however, not always possible, specifically for surgical cuts for hard-to-access bleeding focus. In such instances, utilizing a hemostatic agent effective with irrigation is really a method to stop hemorrhage. Therefore, within the present study, we evaluated the effectiveness of hydrogen peroxide irrigation for control of intraoperative bleeding in pediatric adenoidectomy. Results indicated a significant decrease in both hemostasis and operative times with hydrogen peroxide irrigation ($p < 0.001$ for both, Table 2), where time to hemostasis decreased by approximately 30% and operation time by approximately 35% as compared with the control group. The effect of hydrogen peroxide irrigation on blood loss was indirectly evaluated by the length of hemostasis, and the reduction in hemostasis time by 35% certainly led to a decrease in total blood volume lost in adenoidectomy.

There are some advantages and limitations of the study presented. The same surgeon performed all operations in order to eliminate the effect of the experience of the surgeon in the amount and duration of bleeding after adenoidectomy. In addition, no inter-rater agreement was required for grading of adenoid size. This was a randomized, double-blind, controlled study. The limitations of the current study are the absence of long-term follow-up of the patients to evaluate the effects related to the use of hydrogen peroxide. The number of pediatric patients can be considered small (117 patients), even though it was sufficient to prove statistically significant results of hydrogen peroxide irrigation in terms of hemostasis and operative times. Further studies with larger number of patients and the efficacy of newer techniques, such as suction diathermy or microdebrider, needs to be conducted to prove the efficacy of hydrogen peroxide irrigation in adenoidectomy.

Conclusion

In the present study, we reported the significant effect of hydrogen peroxide solution in reducing the length of hemostasis and operative times in pediatric adenoidectomy. Hydrogen peroxide is readily available and cheap, and its effectiveness when used by irrigation after adenoidectomy is important for containment of inaccessible bleeding foci. Since reducing intraoperative blood loss in adenoidectomy is the goal of all surgeons, and shortening of the procedure has significant economic benefits, hydrogen peroxide solution can be effectively used in adenoidectomy.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Bakırköy Sadi Konuk Training and Research Hospital (2015/05/10).

Informed Consent: Written informed consent was obtained from the parents of the patients.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - H.A., D.H., T.L.K., Y.U.; Design - H.A., D.H., T.L.K., Y.U.; Supervision - H.A., D.H., T.L.K., Y.U.; Resource - H.A., D.H., T.L.K.; Materials - H.A., D.H., Y.U.; Data Collection and/or Processing - H.A., D.H., Y.U.; Analysis and/or Interpretation - H.A., D.H., T.L.K.; Literature Search - H.A., T.L.K., Y.U.; Writing - H.A., D.H., T.L.K.; Critical Reviews - H.A., D.H., Y.U.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support

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