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Hot nasal packing with hot saline irrigation for hemostasis after adenoidectomy: A prospective randomized controlled study

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ABSTRACT

Objective: This study aimed to investigate the efficacy of hot posterior nasal packing and hot saline irrigation in bleeding control after adenoidectomy.

Methods: A total of 130 patients scheduled for adenoidectomy were included in the study, and randomized into two groups at the beginning of the surgical operation. After adenoidectomy, saline impregnated tampon, and saline irrigation at room temperature (22 °C) was applied to the patients in one group while 50 °C saline impregnated tampon and saline irrigation at the same temperature were applied to the patients in the other group. We recorded hemostasis for up to 3 min after tamponade for bleeding control, and the amount of bleeding into the nasopharynx.

Results: The age of the patients ranged from 1.5 to 13 years (mean ± SD: 6.07 ± 3.08 years, and 5.33 ± 2.55 years, 22 °C and 50 °C saline irrigation groups, respectively). There were 37 males and 28 females in the 22 °C saline group, while 34 males and 31 females in the 50 °C saline group. When comparing the two groups, there was no statistically significant difference in terms of duration of hemostasis ($p = 0.64$). However, bleeding scores at 2 nd min after the tamponade were significantly lower in the 50 °C saline group ($p = 0.007$). The amount of bleeding in the 50 °C saline group was also significantly lower than the 22 °C saline group ($p = 0.015$).

Conclusion: In this study, application of 50 °C saline impregnated tampon, and hot saline irrigation was found to be more effective in the control of bleeding after adenoidectomy by reducing the amount of bleeding compared to 22 °C saline impregnated tampon application and saline irrigation at 22 °C. However, hot nasal packing and hot saline irrigation did not affect duration of hemostasis and cauterization.

1. Introduction

Since Meyer first described adenoidectomy in 1868, it has been among the frequently performed surgical procedures in children by otorhinolaryngologists [1–3]. Even though many new high technology techniques have been developed over the years, the conventional adenoidectomy technique is still the most widely used one worldwide [4]. The conventional adenoidectomy technique [5], which was described by Guggenheim in 1957, has been currently performed with Beckman or La Force adenotomes. However, this technique is still considered as a blind technique because the surgeon evaluates the adenoid tissue through digital palpation or with the aid of a mirror [6]. Hemostasis following curettage is performed using tampons, saline irrigation, and bipolar cauterization.

Several hemostatic agents, including Ankaferd blood stopper, hemostatic sealant, adrenaline, feracrylum, QuikClot have been previously used to reduce both the time of operation and intraoperative bleeding in conventional adenoidectomy [4,7–9]. Apart from the use of hemostatic agents, hot saline irrigation following tampon is another technical modification, but limited studies have been available so far [10]. Hot saline irrigation has been widely used in the hemostatic control of posterior epistaxis [11]. Other uses of hot saline irrigation in otorhinolaryngology include endoscopic skull base surgery, neurosurgical procedures, and endoscopic sinus surgery [12].

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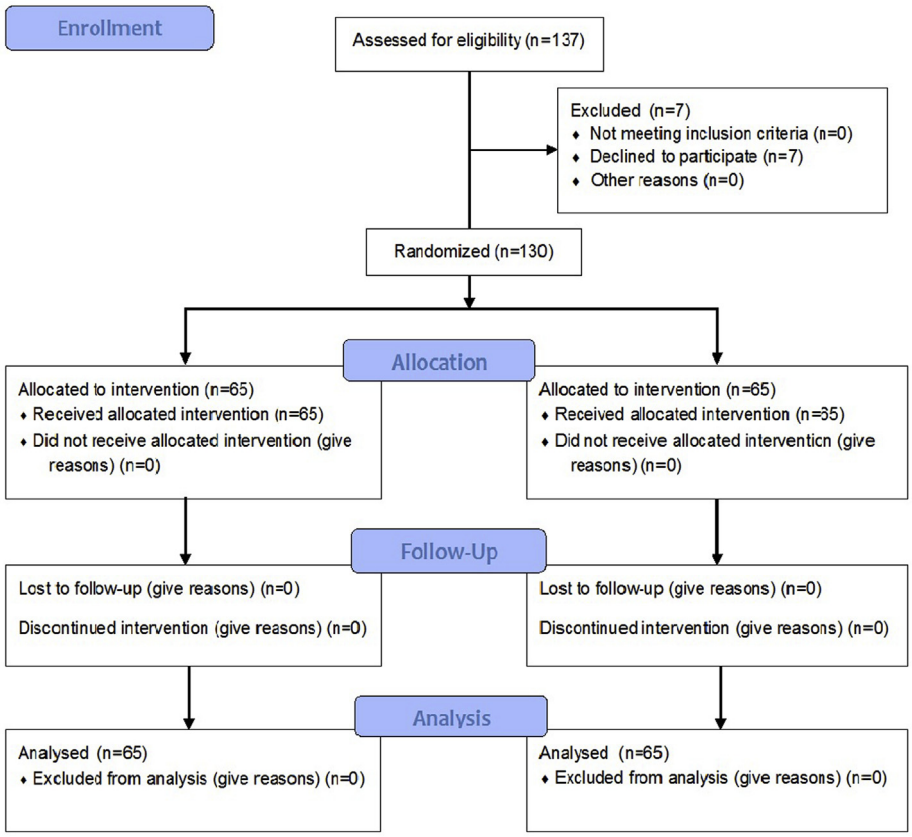

Fig. 1. Patient flowchart of the study according to the CONSORT guidelines for reporting of randomized trials.

Accordingly, this study aimed to investigate the efficacy of hot tampon application and hot saline irrigation (50 °C) for bleeding control after adenoidectomy at room temperature (22 °C) along with comparing its efficacy with packing and saline irrigation.

2. Methods

A prospective controlled randomized, single-blind study was designed to investigate the effect of a hot tampon with hot saline irrigation in hemostasis during adenoidectomy. After the parents signed informed consent, the patients under the age of 16 years, who underwent adenoidectomy due to the chronic nasal obstruction, were included in this study. Patients with chronic diseases, hemorrhagic diathesis, and patients who had additional procedures were excluded from the study. Among 137 patients who met the inclusion criteria, one hundred and thirty patients who agreed to give an informed consent form were included in the study (Fig. 1). In compliance with the WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, the study protocol was approved by the Clinical Research Ethics Committee.

The patients were divided into 22 °C and 50 °C irrigation groups using a computerized random number chart for each working day. To provide blind-evaluation of bleeding by the surgeon, a nurse heated the tampon and water, inserted latex Foley catheters into both nostrils and performed the irrigation processes.

The temperature of the irrigation water and the tampon was adjusted by immersing a thermometer in the mixture of hot and cold water. The temperature of the irrigation fluid was also controlled every minute to make sure it remained at 50 °C (Fig. 2).

All operations were performed under general anesthesia and using a flexible fiberoptic endoscope we attentively assessed the degree of obstruction before the operation in accordance with the following grading system: First degree obstructions (< 25% of the rhinopharynx obstructed), second degree obstructions (< %50 of the rhinopharynx obstructed), third degree obstructions (< 75% of the rhinopharynx obstructed) and fourth degree obstructions (the obstruction was almost total) [13]. Then the patients were laid down with Rose's position which their head and neck were extended without too stretched by placing rolls under the shoulder, the Boyle-Davis mouth retractor was placed, and adenoidectomy was performed using curettes. Complete excision was confirmed by digital palpation and nasopharyngeal mirror. After adenoidectomy, postnasal pack at room temperature or 50 °C was placed in the nasopharynx. Five minutes later, the tampon was removed, and irrigation with 22 °C or 50 °C saline irrigation was applied. The scoring system described by Boezaart et al. [14] was adapted to the nasopharynx and using this scoring system and the direct

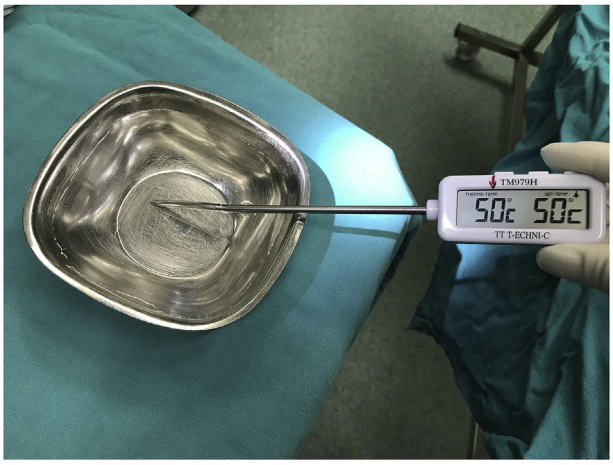

Fig. 2. Checking the temperature of the irrigation water.

visual observation instead of endoscopic scoring, the nasopharyngeal bleeding (if any) was scored and recorded at four different time points: just after tamponing, at the end of one, two and three minutes. The following scoring system was used: 0 = no bleeding, 1 = very slow accumulation of blood in the nasopharynx and slight oozing, 2 = nasopharynx fills with blood if not aspirated intermittently, 3 = blood accumulation in the nasopharynx requiring frequent aspiration, 4 = nasopharynx fills with blood if not continuously aspirated, 5 = severe bleeding which overflows into the oropharynx. The scoring process was terminated when the washing liquid was clean from bleeding during the irrigation. If this washing time was less than 3 min, bleeding scores at remaining time points were also accepted as 0. The irrigation fluids were applied at a rate of about 150 cc per minute and not exceeding 500 cc in total. When the irrigation time exceeded 3 min and bleeding did not show a tendency to decrease, the scoring process was stopped to control the bleeding through bipolar cauterization, and the irrigation was continued with saline at the same temperature. The amount of bleeding was determined by substracting the volume of irrigation fluid from the volume of the material accumulated in the aspirator chamber. The bleeding site and residual adenoid tissue were detected by the nasopharyngeal mirror.

2.1. Data analysis

Through a sample size calculation based on literature, the number of subjects required to evaluate a significant difference in hemostasis time, average grade and need for electrocauterization between adenoidectomized cases receiving 22 ˚C vs. 50 ˚C saline irrigation was determined. We hypothesized that the use of 50 ˚C saline irrigation would lead to at least a 20% difference between the two groups in terms of these parameters. Using this effect size, Type I error of 5% and 80% power (beta of 0.20, Type II error of 20%), 60 patients per arm (group) was required. Therefore, we recruited 65 patients per group (total of 130 patients) for this study.

2.2. Statistical analysis

All statistical analyses were conducted by SAS/STAT version 9.3 (SAS Institute, Inc, Cary, North Carolina, USA). Continuous variables were analyzed by *t*-test for variables with normal distribution, and the Mann-Whitney *U* test for those with non-normal distribution. Chi-square and Fisher's exact test were used to compare the distribution of categorical variables between the two groups. P-values less than 0.05 were considered statistically significant.

3. Results

A total number of 130 consecutive patients were included in this study. Since we used a randomized blocks approach, two balanced groups (22 ˚C and 50 ˚C groups) each including 65 patients were created. The age range of patients was between 1 and 13 years (mean ± SD: 4.5 ± 1.9 years in 22 ˚C saline group and 4.9 ± 1.8 years in 50 ˚C saline group). There were 38 male and 27 female patients in 22 ˚C saline group, 50 ˚C saline group consisted of 34 male and 31 female patients. In 22 ˚C saline group, 49 patients had third-degree and remaining 16 patients had fourth-degree adenoid obstruction. In 50 ˚C saline group 52 patients had fourth-degree adenoid obstruction while the remaining 13 patients had third-degree adenoid obstruction. There was no statistically significant difference between the two groups in terms of age ($p > 0.05$), gender ($p > 0.05$) and adenoid size ($p > 0.05$).

There was no significant difference between the 22 ˚C, and 50 ˚C saline groups in terms of the bleeding scores immediately after withdrawal of the tampon (5 min) and at the 6th minute, ($p > 0.05$). The bleeding scores at the 7th minute were significantly lower in the 50 ˚C saline group ($p = 0.007$) compared to that of 22 ˚C saline group while the bleeding scores at 8th minute were not statistically significantly difference between the groups ($p > 0.05$) (Fig. 3).

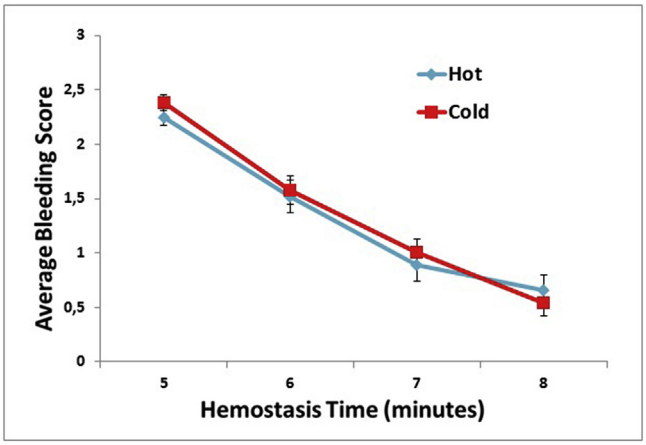

Fig. 3. Change of bleeding scores during hemostasis time in hot and cold group.

There was no statistically significant difference between the two groups at the time of hemostasis ($p = 0.38$). When the two groups were compared in terms of bleeding, the amount of bleeding was significantly lower in the 50 ˚C saline group ($p = 0.015$) (Table 1).

4. Discussion

Although many high-tech methods/tools for adenoidectomy have been developed over the years, adenoid curettes are still the most widely used tools [15]. Serious bleeding rates following adenoidectomy

Table 1
Comparison of hot (50 ˚C) and cold (22 ˚C) groups.

	Hot (N = 65)	Cold (N = 65)	P
	(mean ± SD)	(mean ± SD)	
Age (year)	5.33 ± 2.55	6.07 ± 3.08	0.14
İrrigation time	2.31 ± 1.96	2.45 ± 1.42	0.64
Hemostasis time	7.62 ± 2.27	8.07 ± 2.41	0.38
Mean grade	1.33 ± 0.94	1.35 ± 0.81	0.94
Electrocauterization	%	%	0.85
Yes	29.2	27.7	
No	70.8	72.3	
After pack removal – 5. minute (bleeding score)			0.50
1	9.2	4.6	
2	56.9	53.9	
3	33.9	40.0	
4	0	1.5	
6. minute (bleeding score)			0.26
0	27.7	20.0	
1	23.1	23.1	
2	21.5	38.4	
3	24.6	15.4	
4	3.1	3.1	
7. minute (bleeding score)			0.007
0	56.9	36.9	
1	13.9	32.3	
2	12.3	23.1	
3	16.9	7.7	
4	0	0	
8. minute (bleeding score)			0.13
0	70.8	70.8	
1	1.5	10.8	
2	18.5	12.3	
3	9.2	6.2	
4	0	0	
Mean blood loss	24,75 cc ± 7,03	34,89 cc ± 9,85	0,001

have been reported with the rate of 0.2% that rarely required an external carotid artery ligation [16–18]. Hemostasis in conventional adenoidectomy is traditionally achieved through the diathermy after tampon application. However, excessive electrocauterization may lead to several complications, including nasopharyngeal stenosis, environmental damage to vital structures, severe postoperative pain, as well as the development of Grisel's syndrome [8,19–22]. Thus, limiting the use of electrocautery is essential to prevent such complications. Also, other airway problems such as hypovolemia and pulmonary edema can be prevented with the help of reduction of intraoperative blood loss and shortening of operation time [23,24]. Therefore, the efforts to reduce the amount of intraoperative bleeding and shorten the operation time are of great importance.

Adenoidectomy is rarely associated with bleeding that may cause serious problems as mentioned above. Of course, the number of patients in our study is insufficient to assess the efficacy of hot packing with hot water irrigation for such severe bleeding. The importance of bleeding after adenoidectomy is the length of hemostasis time and less blood loss in the majority of the cases. Therefore, any modification to provide more effective bleeding control after adenoidectomy which is a very common procedure is worthwhile.

Although the safety and efficacy of a new hemostatic sealant (Floseal®) in adenoidectomies of children has been reported to reduce the duration of surgery and the amount of bleeding [7,25], the cost of this hemostatic sealant is very high compared to the cost of hot saline irrigation. On the other hand, Teppo et al. [8] reported that racemic epinephrine also reduces intraoperative bleeding in adenoidectomy. However, the use of topical adrenaline was not found as useful as hot saline irrigation, in addition it carries risk of systemic side effects [10]. Moreover, Abdallah et al. [4] used Ankaferd blood stopper (ABS) and feracrylum 1% solution (FS) as the topical blood stopper modulator during adenoid surgery, and they showed that they were easy to use, safe and reliable [4]. Though both of these agents are superior to hot saline irrigation, they cause additional costs in the surgery.

We did not find any studies in the literature about whether increasing the temperature of the tampon placed in the nasopharynx affects the amount of bleeding and the duration of hemostasis. However, it is essential to note that Haraji et al. [26] previously applied gauze, heated to 42 ˚C in saline, to the extracted dental sockets and reported that they reduced the amount of bleeding compared to the gauze dressing used at room temperature. The results of our study, on the other hand, showed that the application of hot packing did not result in a significant change in the amount of bleeding. However, similar to the practice of Haraji et al. [26], future studies involving the repeated hot tampon applications may show whether hot tampon application affects the duration of hemostasis.

For the first time, obstetricians used hot water irrigation to control postpartum hemorrhages more than a hundred years ago [27]., In otorhinolaryngology, it was first used by Guice and Fayette in 1878 to treat intractable epistaxis [28]. Apart from its use in posterior epistaxis, hot saline irrigation has been widely used in sinus, skull base surgery and neurosurgical procedures. On the other hand, there has been only one study available in the literature reporting the use of hot saline irrigation in bleeding control after adenoidectomy. In this study, Ozmen and Ozmen [10] applied irrigation with 25 ˚C and 50 ˚C saline for bleeding control after adenoidectomy and reported that hot saline irrigation reduced hemostasis and operation time. However, the effect of hot saline irrigation on the amount of bleeding was not evaluated in this previous study. In our study, we found that hot saline irrigation did not affect the duration of hemostasis. This may be associated with longer packing time that may have affected the results. Also, the mean duration of hemostasis was found to be shorter in our study (7.62 min vs. 9.5 min in Ozmen's study).

For the purpose of explaining the hemostatic effect of hot water irrigation, Stangerup and Thomsen [29] investigated the histological changes in the nasal mucosa by applying hot water irrigation at temperatures ranging from 40 ˚C to 60 ˚C for 5 min intranasally in an experimental model of rabbits [29], and reported lack of histological changes for irrigations with 40 ˚C and 46 ˚C while there was a narrowing of the intranasal lumen after vasodilation and edema in the mucosa when the temperature of saline irrigation solutions raised between 46 ˚C and 52 ˚C. They further showed that irrigation at 52 ˚C and above lead to epithelial necrosis [29]. Accordingly, the edema due to the hot water irrigation results in bleeding control through compression of the leaking vessel. Another mechanism involves the decrease of intraluminal pressure by decreasing blood flow due to vasodilation in the mucosal vessels. Another possible mechanism is that the increase in temperature may upsurge the enzymatic activity involved in the coagulation cascade [30,31]. In our study, considering the amount of possible heat loss from the catheter to the nasopharynx, we set the temperature of the tampon and irrigation fluid in the nasopharynx to 50 ˚C to obtain a temperature above 46 ˚C in the nasopharynx. The temperature measured in the nasopharynx was 48 ˚C.

Unfortunately, there is no universally accepted standard scoring method to evaluate nasopharyngeal bleeding after adenoidectomy. Therefore, we adapted the Boezaart bleeding score in our study to evaluate the bleeding area in the nasopharynx by direct visual observation and aspiration of the bleeding. Boezaart bleeding scoring has been widely used in the evaluation of the amount of bleeding in endoscopic sinus surgery [12,14,32]. When considering the bleeding scores, the better scores in the hot saline irrigation group at the second minute after removing the tampon indicated that hot saline irrigation reduces the amount of bleeding. This evident effect at the 2 nd min may be due to the reflex vasoconstriction apparent during this period and the increased edema in the surgical field. No statistically significant difference in the scores at the 8th minute could indicate that the bleeding was also stopped in the cold irrigation group with time. Even this outcome may be interpreted such that hot water irrigation alone does not affect the bleeding time very much, but reduces the amount of bleeding. On the other hand, the total amount of bleeding was also measured in our study beyond the subjective evaluation, and the total amount of bleeding was significantly lower in hot saline irrigation.

The amount of bleeding and the duration of hemostasis is also significantly related to both the technique used and the experience of the surgeon. Since in our study the same surgeon performed all surgeries, this factor was eliminated for both groups. Boezaart scoring was not applied for prolonged bleeding that persisted for more than 3 min and did not show a tendency to decrease. It was thought that prolonged bleeding and/or cauterization may impair standardization in terms of Boezaart scoring when comparing the two methods. In such cases, additional methods of detecting the bleeding point when performing bleeding control, such as the use of a nasopharyngeal mirror, the use of a catheter to lift the palate, may make it difficult to assess the effect of hot water irrigation on hemostasis. In addition, continuing irrigation in bleeding that does not tend to decrease may increase anesthesia and surgery time and it is unclear when cauterization should be used. In our study, the use of cautery may not show a significant difference in both groups, as we limited the irrigation time.

5. Conclusion

Our cumulative results suggest that irrigation with 50 ˚C saline significantly reduces the amount of bleeding after adenoidectomy compared to irrigation with 22 ˚C saline. However, it does not influence duration of hemostasis and the rate of electrocautery usage. Also, any positive effect of hot tampon application on bleeding was not observed in this study. Nevertheless, future studies are still needed to determine precisely whether use of hot tampon shortens bleeding time.

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Declaration of competing interest

The authors have no competing interests.

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