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Aqua Cauterization: A New Technique for Adenoidectomy

Sulu Koterizasyon: Adenoidektomi İçin Yeni Bir Teknik

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ABSTRACT Objective: Adenoidectomy is one of the most frequently performed surgical procedures in pediatric patients. This study investigated the use of aqua-bipolar cautery as a novel method for controlling bleeding during adenoidectomy; aiming to evaluate its effectiveness in reducing postoperative bleeding and preventing adenoid tissue regrowth compared with traditional cautery techniques. **Material and Methods:** This study included 655 pediatric patients undergoing adenoidectomy. Two groups were formed: one group underwent surgery using the traditional cauterization method, while the other underwent surgery using the saline cauterization technique. Patients were retrospectively examined for postoperative bleeding and adenoid tissue recurrence. **Results:** A total of 375 patients were assigned to the control group and 280 to the study group. No cases of postoperative bleeding requiring hospitalization were reported in either group. Only one patient in the control group experienced adenoid tissue regrowth. The statistical analysis revealed no significant differences between the two groups in terms of postoperative outcomes. **Conclusion:** Aqua bipolar cautery is a safe alternative for adenoidectomy, but its superiority over conventional methods requires more extensive investigation.

Keywords: Adenoidectomy; aqua-bipolar cautery; bipolar cautery; postoperative bleeding; adenoid tissue regrowth

ÖZET Amaç: Adenoidektomi, yaygın bir pediatrik cerrahidir. Bu çalışma, kanama kontrol yöntemi olarak sulu koterizasyon kullanımını önermekte ve bu yöntemin geleneksel koterizasyon teknikleriyle karşılaştırıldığında postoperatif kanama ve adenoid dokunun yeniden büyümesi üzerindeki etkisini değerlendirmektedir. **Gereç ve Yöntemler:** Çalışmaya, adenoidektomi geçiren 655 pediatrik hasta alınmıştır. İki grup oluşturulmuştur: Bir grup geleneksel koterizasyon yöntemi ile diğer grup ise sulu koterizasyon yöntem kullanılarak opere edilmiştir. Hastalar postoperatif kanama ve adenoid dokunun yeniden büyümesi açısından geriye dönük olarak incelenmiştir. **Bulgular:** Hastalar arasında 375 kişi kontrol grubunda ve 280 kişi çalışma grubunda yer almıştır. Her iki grupta da hastaneye yatış gerektiren postoperatif kanama rapor edilmemiştir. Kontrol grubunda sadece bir hastada yeniden adenoid doku büyümesi gözlemlenmiştir. İstatistiksel analiz, iki grup arasında anlamlı bir fark bulunmadığını ortaya koymuştur. **Sonuç:** Sulu koterizasyon, adenoidektomi için güvenli bir alternatif yöntem olarak görülmesine karşın geleneksel yöntemlere üstünlüğü daha kapsamlı araştırmalar ile incelenip ortaya konması gerekmektedir.

Anahtar Kelimeler: Adenoidektomi; sulu koterizasyon; bipolar koterizasyon; postoperatif kanama; adenoid doku yeniden büyümesi

Adenoids and tonsils play vital roles in the defense of the host's upper respiratory tract defense against pathogens. These lymphoid structures collectively form the Waldeyer ring, encircling the naso- and oropharynx. The adenoid tissue resides in the nasopharynx, extending from just beneath the nasal septum to the posterior nasopharyngeal wall.[1-3] Unlike tonsils, it lacks a distinct encapsulated structure.[4]

Adenoidectomy is one of the most commonly performed surgical procedures in children, substantially enhancing their quality of life and overall health when indicated.[1,5,6] Given its frequent application, evidence-based recommendations are regularly reviewed and updated.[7]

In general, adenoidectomy is associated with a low risk of complications. The primary concern as-

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sociated with adenoidectomy is the potential for postoperative bleeding; which in some cases, may require hospitalization and intervention under general anesthesia. Furthermore, due to the non-encapsulated nature of adenoid tissue, complete removal is not always guaranteed. Consequently, one of the complications that can arise is the symptomatic re-growth of adenoid tissue, which often necessitates revision surgery. Other rare complications of adenoidectomy include; velopharyngeal insufficiency (characterized by hypernasal speech and nasal regurgitation), nasopharyngeal stenosis, and scarring of the Eustachian tube.[8,9]

Various techniques exist for performing adenoidectomy; with traditional cold excision using loop adenoid curettes being an option. However, recent years have seen a decline in its preference; with many clinicians opting for micro-

Debridement and electrocautery adenoidectomy. Hot adenoidectomy techniques, such as standard bipolar or monopolar coagulation; result in shorter operation times and less operative bleeding compared with cold coagulation techniques.[10]

In our investigation, we explored an alternative method for controlling adenoid hemorrhage using the aqua bipolar cautery technique. Originally designed for managing hemorrhages in delicate tissues like the liver, this technique offers distinct advantages.[11] Unlike standard bipolar cauterization, aqua-bipolar cauterization allows for cauterization in watery or bloody environments without aspiration. This approach is believed to minimize tissue damage during both cauterization and removal due to the absence of direct tissue contact, which we take advantage of, especially in the control of hereditary hemorrhagic telangiectasia bleeding. The tissue temperature during aqua-bipolar cautery does not increase beyond 100°C, ensuring a more controlled and superficial cauterization compared to the classical dry bipolar cauterization method, which reaches 300° Celsius.[12]

Our study aimed to answer the following pivotal question: Does the aqua-bipolar cautery technique significantly differ in terms of bleeding and adenoid tissue regrowth during the postoperative period compared with classical cautery techniques in adenoidectomy?

MATERIAL AND METHODS

This retrospective study focuses on patients undergoing adenoidectomy for indications related to obstructive sleep apnea and/or recurrent/chronic middle ear infections. The Başkent University Ethics Committee (date: October 27, 2023, no: 281063) approved the study. The study was conducted in accordance with the principles of the Declaration of Helsinki. The study included 655 patients aged between 5 and 12 years who were diagnosed with adenoid hypertrophy and underwent adenoidectomy using cold curettage between February 2018 and February 2022 at the Otolaryngology Department of Başkent University Hospital. None of the patients included in the study had a known history of bleeding disorders or syndromic diseases that would predispose them to bleeding or cause delayed wound healing. Informed consent was obtained from the parents of all children.

Adenoid tissue was removed in all patients using the curettage technique with an adenotome, employing a consistent surgical approach. The patient cohort was subsequently categorized into two groups: the control group, which underwent conventional dry-field cauterization, and the study group, in which aqueous cauterization was employed. The study and control groups comprised 280 and 375 patients, respectively.

In the conventional cauterization method, the tips of the bipolar cautery device make direct contact with the bleeding area, while being observed with a laryngeal mirror, generating the necessary heat through the electric current between the two bipolar probes for effective bleeding control. In aqueous cauterization, bipolar cautery functions on the same principle; however, bleeding control is accomplished through heat conduction through saline solution (SS) (Figure 1). This technique is similar to commercially available irrigation-coupled cautery devices that use radiofrequency energy from a standard electrosurgical generator along with saline irrigation to transfer thermal energy. The saline acts as a conductive fluid at the tip of the device and cools the tissue surface, ensuring that the temperature does not exceed 100°C. In contrast, conventional electrosurgery can reach

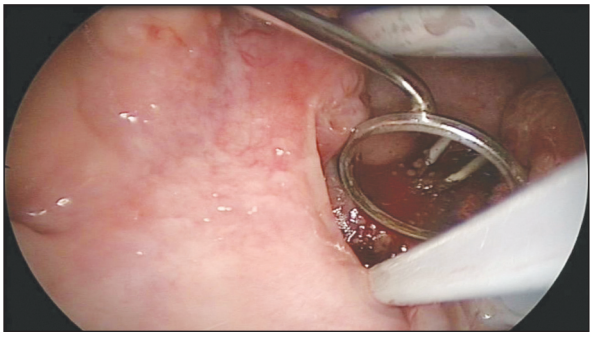

FIGURE 1: An aqua-bipolar cauterization is seen. Please note that the saline solution pooling in the nasopharynx and the tip of the angled bipolar cauter is visible through the laryngeal mirror.

temperatures >300°C. Compared with the traditional cautery method, the Aqua bipolar cautery conducts heat with the conductivity of the ions in the saline fluid in the area where the saline fluid is located without taking the tissue between the tips of the cautery, performs minimal tissue charring with controlled precision, and provides deeper tissue coagulation.

In addition to a standard bipolar electrocautery forceps (Valleylab, USA), the necessary supplementary materials include a standard 20-cc syringe and 500 mL of 0.9% sodium chloride (saline) solution, both of which are readily available at any hospital. The syringe is subsequently filled with saline and used during the procedure to irrigate the bleeding area, ensuring that the surface remains moist according to the width of the hemostatic area to achieve the desired tissue effect. This approach eliminates the risk of traumatization that may occur when removing the bipolar from the bleeding tissue post-cauterization because it avoids direct contact with the tissue.

After the procedure, patients were discharged if they demonstrated good oral intake and did not have bleeding. All patients in both groups received postoperative antibiotics (amoxicillin-clavulanate, 40 mg/kg, twice daily) and paracetamol (15 mg/kg as needed).

To evaluate the results, we evaluated the patients in both groups in terms of bleeding events requiring hospitalization or intervention under general anesthesia as well as adenoid tissue hypertrophy that may require re-adenoidectomy by questioning a mean retrospective period of 2-6 years. Adenoid tissue hypertrophy that may require re-adenoidectomy was evaluated by assessing whether the patients' preoperative complaints persisted. In 15 patients who had no significant improvement in their complaints, no growth in adenoid tissue was observed on nasal flexible endoscopy performed in postoperative controls. All data were collected by examining hospital records and correlatively by telephone interviews with the patients after the surgical procedure.

Categorical data are presented as counts (n) and percentages (%). To compare nonparametric data between the study and control groups, the Mann–Whitney U test was employed. For the comparison of categorical data, we used the chi-square and Fisher exact tests. Statistical significance was set at p-values<0.05. All statistical analyses were performed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA.

RESULTS

Our study included 655 patients, aged 2-14 years; who presented with complaints of mouth breathing, snoring, and nocturnal breathing difficulties. Among these patients; 365 were female and 290 were male. Of the total cohort; 375 patients were included in the control group, whereas the remaining 280 comprised the study group. There were no reported incidents of postoperative bleeding requiring hospitalization in either group. Furthermore, postoperative adenoid tissue hypertrophy was observed in only one patient from the control group; with no such occurrences noted among the study group (Table 1). The statistical analysis; with a p-value of 1, confirmed the absence of a significant difference between the groups.

Subsequent subgroup analyses: Considering patient age, sex, and the type of cauterization (traditional vs. aqueous cautery); also revealed no significant disparities were observed between the two groups concerning postoperative hospitalization due to bleeding or adenoid tissue hypertrophy necessitating re-adenoidectomy during the postoperative period.

DISCUSSION

Adenoidectomy is a commonly performed surgical procedure that has been continuously refined over the years through the adoption of new techniques and

TABLE 1: The number of patients participating in the control and study groups, the number of patients with postoperative bleeding, and the number of patients with postoperative adenoid tissue regrowth.

	Control group (n=375)	Experimental group (n=280)
Bleeding	0	0
Recurrence	1	0

equipment. However, the effort to reduce the incidence of complications remains significant. patients who experience less postoperative pain after adenoidectomy benefit from improved oral intake, reduced dehydration, lower postoperative bleeding risks, and shorter hospital stays.[13] These positive outcomes also contribute to a decrease in healthcare costs associated with the procedure, thereby emphasizing the importance of minimizing pain and trauma as a primary objective.[14]

In our study, we aimed to evaluate whether the aqua-bipolar cautery technique, an alternative method that potentially causes less thermal damage, creates a significant difference in postoperative bleeding and adenoid tissue regrowth compared with traditional cautery techniques. Thereforebe we hypothesize that the aqua-bipolar cautery technique, preferred in liver transection, could be a safer method for controlling bleeding during adenoidectomy.

One of the most significant complications of adenoidectomy is postoperative bleeding, with reported rates of 2-4% following cold steel adenoidectomy.[15] A study examining 7,946 adenoidectomy cases using bipolar coagulation for hemostasis between 1995 and 2014 found that only 4 patients (0.09%) experienced this life-threatening complication.[16] In the control group, the incidence of major postoperative bleeding was 0.3%. Even with relatively large cohorts, determining whether aqua-coagulation can further improve an already very low bleeding rate would be challenging; however, our insights suggest potential benefits of this technique.

Residual adenoid tissue or regrowth can necessitate revision surgery as undesirable outcomes of adenoidectomy. the removal of adenoid tissue is not as thorough as that of extracapsular tonsillectomy, with reported regrowth rates ranging from 1% to 9%. Symptomatic adenoid regrowth occurs in approximately 1%-3% of cases. The revision surgery rates are fairly consistent across commonly used instruments, with rates of approximately 0.84% for the microdebrider, 1.5-1.7% for suction coagulation, and approximately 1.6% for curettage.[17] In our study, the revision rate in the control group was approximately 0.3%, which is lower than the reported rate. Once again, due to the size of our study group, it is difficult to reach a definitive conclusion regarding whether aquacoagulation can further improve revision rates.

In liver transection, the sequential ligation of peripheral sensitive Glisson tissue and very thin hepatic veins is a time-consuming process with a risk of failure. Ultrasonic devices are used alongside bipolar coagulation to coagulate small structures to control bleeding and bile leakage. Additionally, the bipolar coagulation device is equipped with a channel for saline irrigation to prevent the adhesion of coagulated tissue and rupture of sensitive vessels. This system is used in liver transection and is the basis of our study.[18]

In liver transection, the surgical technique involves connecting a monopolar device to a compatible electrosurgery generator with a power output of 70 W. RF (480 kHz) energy is focused at the tip of the device and is transmitted alongside low-flow SS (one drop per second) to induce tissue thermocoagulation. The continuous flow of saline also cools the tissue surface to temperatures below 100°C, thereby preventing charring and eschar formation.[19,20] The technique used in our study is similar to commercially available irrigation-coupled cautery devices, which use radiofrequency energy from a standard electrosurgical generator in conjunction with saline irrigation to transfer thermal energy. The 0.4% NaCl solution is a conductive solution due to the presence of Na+ and Cl ions, making it a good conductor. This good conductivity allows the aqua bipolar coagulation method to create less resistance and heat between the bipolar tips and tissue. In traditional bipolar coagulation meth-

ods, temperatures can reach approximately 300°C. Since the boiling point of water at sea level is 100°C, the maximum temperature between the two electrodes cannot exceed 100°C. This results in a more superficial and less traumatic coagulation compared with the traditional method.[12,19-22] Additionally, in traditional methods, non-stick bipolar tips are not preferred due to cost considerations. This may lead to issues such as the formation of crusts when removing bipolar tips from bleeding tissue, potentially causing re-bleeding.

The application of bipolar coagulation with saline irrigation limits the maximum temperature reached at the tip of the bipolar electrodes and reduces the depth of thermal tissue damage. As a result, it provides more superficial coagulation while affecting a wider area compared to traditional bipolar coagulation.[21-23] We think that aqua-bipolar coagulation could be beneficial in managing potential residual tissues, particularly the remnants behind the vomer, as attempting to remove these tissues through adenoid curettage poses a risk of muscular trauma, making them candidates for coagulation. This technique is cost-effective and can be performed using readily available surgical equipment. We prefer angled bipolar coagulation, which reduces the need for angled endoscopes. We propose that aqua-bipolar coagulation is an effective method for preventing the regrowth of residual lymphoid tissues, controlling bleeding, and mitigating increased postoperative pain due to thermal damage in the underlying muscles.[24-26]

CONCLUSION

In our study, we did not observe any significant differences between conventional cauterization, the commonly preferred method for controlling bleeding during adenoidectomy, and aqua- bipolar cautery; regarding postoperative bleeding, hospitalization rates, and recurrent adenoid hypertrophy.

Expanding the study with a larger patient population in a longer postoperative period will help achieve healthier results.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Emre Önal, Erdinç Aydın;* ***Design:*** *Emre Önal Onur Ergün;* ***Control/Supervision:*** *Emre Önal;* ***Data Collection and/or Processing:*** *Emre Önal;* ***Analysis and/or Interpretation:*** *Onur Ergün, Erdinç Aydın;* ***Literature Review:*** *Emre Önal;* ***Writing the Article:*** *Emre Önal;* ***Critical Review:*** *Erdinç Aydın;* ***References and Fundings:*** *Onur Ergün, Erdinç Aydın;* ***Materials:*** *Erdinç Aydın.*

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