Original article

Alum Usage for Control of Epistaxis as an Alternative to Silver Nitrate

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Abstract

Background and Aims:
Silver nitrate is well known as an effective topical treatment for epistaxis. It has some disadvantages like the local burn extension and the noxious smell that stimulates lacrimation and sneezing. Alum, on the other hand, has been used in the medical field to control bleeding by different specialties. If alum which does not have silver nitrate disadvantages can control epistaxis more efficiently, it would be a better alternative.
The aim of this study is to compare the efficacy and the outcome of silver nitrate and alum in control of epistaxis.

Methods:
This is an experimental animal study on 15 rabbits divided into 3 groups. A similar incision was made in the nose of all rabbits in the 3 groups. In the first group silver nitrate was used to stop bleeding, in the second alum was used and the third was left for spontaneous cessation of bleeding. The mean time needed for cessation of bleeding was measured and compared. One week later, one biopsy from the healed

الملخص

الخلفية والأهداف:
نترات الفضة تعتبر من العلاجات الموضعية المعروفة والفعالة في علاج الرعاف. نترات الفضة لها بعض العيوب مثل امتداد الحرق في أنسجة الأنف والرائحة القوية التي تحفز على زيادة افراز دموع العين وكذلك استثارة العطاس. من ناحية أخرى، الشب تم استخدامه في المجال الطبي للسيطرة على النزيف بواسطة تخصصات مختلفة. إذا كان بإمكان الشب الذي لا يحتوي على عيوب نترات الفضة التحكم في الرعاف بشكل أكثر كفاءة ، فسيكون ذلك بديلاً أفضل.
الهدف من هذه الدراسة هو مقارنة فعالية ونتائج نترات الفضة والشب في السيطرة على الرعاف.

طريقة البحث:
هذه دراسة تجريبية على ١٥ أرنب مقسمين إلى ٣ مجموعات. حيث تم عمل جرح مماثل في الأنف في جميع الأرانب في المجموعات الثلاث. في المجموعة الأولى ، تم استخدام نترات الفضة لوقف النزيف ، وفي المجموعة الثانية تم استخدام الشب, والثالثة تركت من دون تدخل حتى توقف النزيف تلقائيا.
تم قياس ومقارنة متوسط الوقت اللازم لوقف النزيف. بعد أسبوع واحد ، تم أخذ خزعة واحدة من جرح ملتئم من المجموعة ١ وخزعة أخرى من المجموعة ٢ لدراسة مدى وطريقة التئام الجرح مجهريا.

incision was taken from group 1 and another biopsy from group 2 for histopathology.
Results: The bleeding stopped faster in the second group, for which alum was used, in comparison to the other two groups. The histopathological findings in the biopsies taken showed better healing in the wound on which the alum was used.

Conclusion:
Alum is a better alternative to silver nitrate in control of epistaxis. It controls bleeding in a shorter time, and also result in better healing characteristics when compared to silver nitrate.

Keywords:
Aluminum; Epistaxis; Silver nitrate; Therapeutics.

النتائج:
توقف النزيف بشكل أسرع في المجموعة الثانية ، التي استخدم فيها الشب ، مقارنة بالمجموعتين الأخريين. وأظهرت النتائج المجهرية في الخزعات التي تم دراستها ان التئام الجرح أفضل في الجرح الذي تم استخدام الشب فيه.

الخلاصة:
الشب هو بديل أفضل لنترات الفضة في السيطرة على الرعاف. إنه يتحكم في النزيف في وقت أقصر ، ويؤدي أيضًا إلى تحسين خصائص الشفاء بالمقارنة مع نترات الفضة.

Introduction

Bleeding of the nose has a prevalence of almost 10%, and about 10% of them need medical care. It affects most commonly the children and the old age population with comorbid conditions. It is one of the common emergency situations that are seen almost on daily practice by family and emergency physicians and by otolaryngologists.

There are many treatment options for treatment of epistaxis depending on many factors like the cause of the bleeding, the severity and site of the bleeding and the overall medical condition of the patient. These options may range from simple first aid procedures like pressing over the nose in mild cases to outpatient procedures like chemical or electrical cautery, topical decongestant and nasal packs to more aggrieve procedures like surgical ligation or embolization of the bleeding vessel in rare occasions with major recalcitrant bleeding. Having many treatment options make it very crucial to choose the right and the best available treatment modality for each patient to improve the practice and to reduce the incidence of morbidity associated with management of these emergencies.

Little's area on the anterior nasal septal mucosa is by far the most common site of epistaxis especially in children. In most patients, the bleeding is readily seen and

diagnosed by anterior rhinoscopy which shows the bleeding point/s on the nasal septum. Such bleedings are usually treated by chemical cautery (silver nitrate) or electrical bipolar cautery, with the first option being preferred in most cases as it is cheaper, easier and widely available.

Little in 1932 was the first to describe silver nitrate as an effective topical treatment for epistaxis.[1] Silver nitrate in an aqueous environment acts as a strong oxidizing agent, stimulating the production of free radicals which cauterize the involved tissue and stop the bleeding.[2] Its availability as stick applicator makes its usage very convenient for both physicians and patients. However, it has some disadvantages like its noxious smell which stimulates lacrimation and sneezing which may actually aggravates the epistaxis by increasing the intracranial pressure. Another disadvantage is the deep and wide local burn extension, which may result in long-term complications like nasal septal perforation due to tissue necrosis, especially in patients who were exposed to silver nitrate several times.[3] Tissues cauterized by silver nitrate will show cell death and thrombosis of vessels during the healing process, which eventually will lead to necrosis and repair as part of the inflammatory response after exposure to silver nitrate.[4]

Moreover, silver nitrate causes pain due to the chemical burn of the tissues which may necessitate the use of analgesics.[5] It could be also associated with palatal numbness, thermal injury to neural structures, nasolacrimal duct obstruction and injury to optic nerve especially in patient who underwent sinus surgery and ethmoidectomy previously.[6,7]

If alum which does not have these disadvantages can control epistaxis with better outcomes, it would be a better alternative. Alum has also the advantages of being cheap and easy to handle as it can be produced as stick applicators. Alum is a natural mineral salt. Its production is easy and cost effective. It has no color, no odor and it is soluble in water. Chemically, alum is a double salt of aluminum or potassium aluminum sulfate
(Alum, KAl [SO4] 2 _12H2O).[8]
Alum has been used widely since ancient times. It is used in industry to tan leather because it precipitates hide proteins. Also, it is used by barbers for refreshing the skin and to stop bleeding after shaving. It has been used in different industries like the production of textiles, paints, papers and deodorants.

Efficacy of alum is highly variable in medical fields depending on its concentration.

It acts as an astringent at concentrations higher than 0.5% by precipitating proteins over a bleeding surface.[9,10] Conversely, it may causes inhibition of platelet aggregation at concentrations of 0-1%.[11]

Alum, beside its protein precipitation, has low cell penetrability which limits its action to the surface of the cell and interstitial spaces, so the cells remain viable. Another advantage of alum is the low systemic absorption from topical application. [12] Alum excretion is through the kidneys, an increased serum levels can occur in patients with renal impairment and this may results in prolonged prothrombin time.[13]

The aim of this study is to ascertain whether alum can be a better alternative to silver nitrate in controlling epistaxis or not in terms of the time needed to stop bleeding and the healing characteristic.

Materials and Methods

This is an experimental animal study. It was carried out in the animal laboratory at College of Medicine, King Faisal University, Saudi Arabia. The study was approved by the institutional review board (IRB) at College of Medicine, King Faisal University. All animals received human care as the study protocol complied strictly with the guidelines of research on animals at King Faisal University.

Three groups of albino rabbits were used in this study, each group composed of 5 rabbits weighing 1800 ± 50 grams. Intraperitoneal injection of 120 mg thiopental was used for anesthesia on each rabbit, after almost 5 minutes the rabbit slept. An incision was made in right side of the nose of the rabbit on the nasal septum, at the little's area. This procedure was done for the all 15 rabbits, the incisions made in all rabbits were exactly similar with regards to site, depth and length.

First group was cauterized with silver nitrate sticks, in the second alum sticks (aluminum sulfate) was used and the third was left for spontaneous cessation of bleeding. The mean time for cessation of bleeding was measured in the 3 groups. After that, the rabbits were kept individually in cages at a constant temperature of 25 °C with access to food and water.

One week later, one biopsy from the healed incision was taken from one rabbit in group 1 and another biopsy from one rabbit in group 2 for histopathological analysis. The site of the biopsy was packed by gauze soaked in decongestant till haemostasis was achieved at the biopsy site.

The biopsy included a full thickness tissue from the wound, and the adjacent mucosa, and they were fixed immediately in formalin and cut into 4-μm-thick sections. Sections were stained with hematoxylin and eosin stain and examined by a microscope. The slides were examined by using a 400× objective lens of a light microscope (Nikon, Tokyo, Japan) which was connected to a digital camera (Coolpix990; Nikon). Two blinded histopathologists helped in preparation of the slides and in confirming the microscopic findings.

One-way analysis of variance (ANOVA) test was used to compare the different means, then a post-hoc test was done to compare inter-group difference by using the tukey's honest significant difference (Tukey's HSD) test. Analysis was performed using the SPSS program version 20 (IBM Corp., Armonk, NY, USA). A P value <.05 was considered statistically significant.

Results

The mean time needed for cessation of epistaxis was calculated in the 3 groups as shown in table 1. It was lowest with 29.4 seconds in group 2 in which alum was used, 36.4 seconds in group 1 for which silver nitrate was used, 45.6 seconds in the third group in which the incision was left for spontaneous cessation of bleeding. This difference was statistically significant. Tukey's HSD test for inter-group comparison was calculated as shown in table 2, and the difference was statistically significant between all groups.

The gross appearance of the incisions after

Table 1: Mean Time for Cessation of Bleeding in the Different Groups.

Group	Mean Time for cessation of bleeding in seconds ± SD	One way ANOVA, *P* value
Group 1 (silver nitrate)	36.4 ± 3.4	.000013
Group 2 (alum)	29.4 ± 2.7	
Group 3 (spontaneous cessation of bleeding)	45.6 ± 3.4	

Table 2: Inter-group Comparison of Means for Cessation of Bleeding.

Group	Means (seconds)	Tukey's HSD test *P* value
Group 1 vs Group 2	36.4 vs 29.4	.011
Group 1 vs Group 3	36.4 vs 45.6	.002
Group 2 vs Group 3	29.4 vs 45.6	.001

the control of bleeding was clean and clear with alum with no black discoloration and eschar formation as seen when silver nitrate is used.

One week later, one specimen from group 1 and another specimen from group 2 underwent histopathological analysis (as seen in figure 1 to figure 4).

Figures 1 and 2 show healing of nasal tissue one week after silver nitrate cautery of the rabbit.The sections show stratified squamous epithelium with areas of ulceration, and overlying exudate, areas of hemorrhage with underlying granulation tissue. There are areas of inflammatory infiltrate rich in eosinophils in the sub-epithelial tissue. These findings are indicative of an active ongoing healing process.

Fig. 1. Histopathology for healing of nasal tissue, 100X. It shows an active ongoing healing process after 1 week from exposure to silver nitrate, with areas of ulceration and granulation tissue.

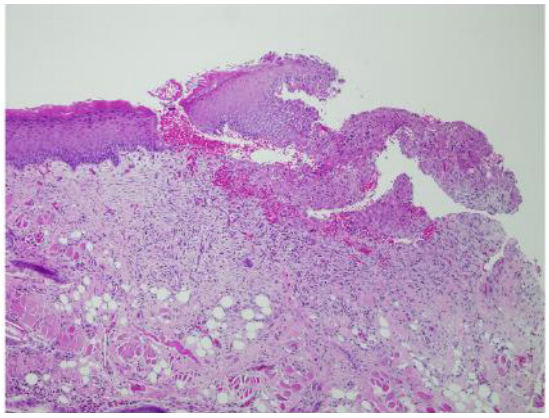
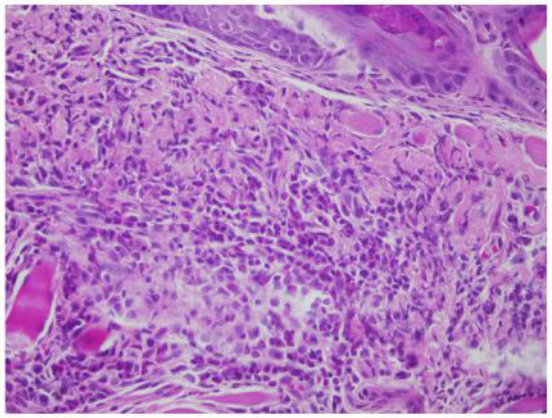


Fig. 2. Histopathology for healing of nasal tissue, after silver nitrate cautery, 400X.



Figures 3 and 4 show better healing characteristics of nasal tissue of the rabbit one week after exposure to alum. The sections show a near complete healing with stratified squamous epithelial lining cells with mildly distended superficial cells and areas of hemorrhage and minimal inflammatory infiltrate in the sub-epithelial tissue with no ulcers.

Fig. 3. Histopathology for healing of nasal tissue, 100X. It shows better healing characteristics and a near complete healing after 1 week from exposure to alum.

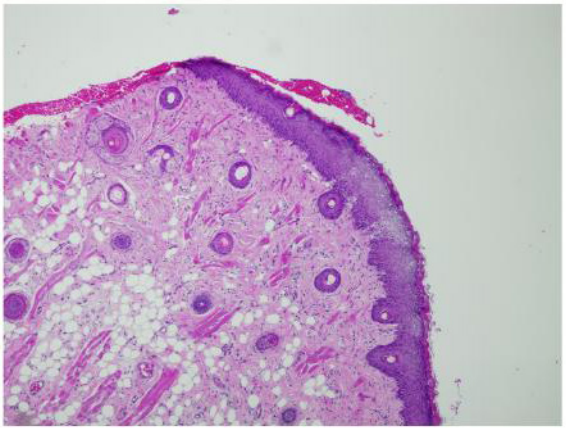
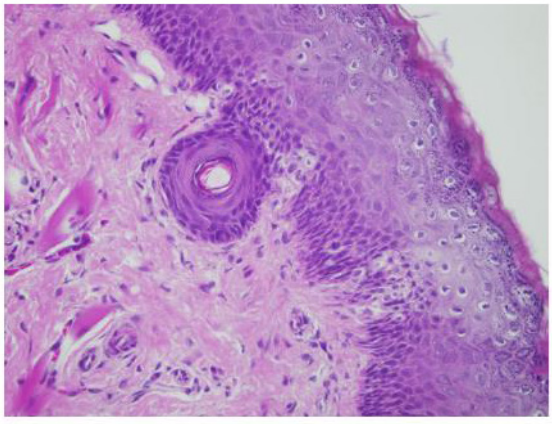


Fig. 4. Histopathology for healing of nasal tissue after using alum, 400X.



Discussion

While Muslims go for trimming or shaving their scalp off hairs as a last step of Umra (Muslims visiting Mecca), it is common to see barbers stop scalp bleeding with alum in a fast manner. So, alum is well known and has been used for long time by barbers for treating shaving injuries. In fact, Alum was used and described in Greek medicine and also by traditional medicine in different cultures.

Alum usage was also described widely in recent literature for different medical indications, like its antibacterial effects and its efficacy on the healing of oral ulcers. [14,15]

Searching the literature, no previous papers were found that have assessed the efficacy of alum in comparison to silver nitrate for the control of epistaxis or the mucosal wound healing after exposure to silver nitrate and alum. There are many published articles in other medical specialties about the usage of alum for control of bleeding in different sites.

Urologists used 1% alum solution as irrigation for control of uncontrollable hematuria in cases of non-operable cancer of bladder.[16] Irrigation of bladder with alum stops bleeding by two different mechanisms. First, it causes capillary constriction and second by precipitating of protein gel over the bladder wall.[17]

Ostroff and Chenaultin in 1982 were the first to report complete stop of hematuria with 1% alum solution in patients with massive bladder bleeding.[18] They did not report side effects of this treatment, which could be given with no anesthesia. After this study, several publications were reported,[9][19 - 21] with success rates between 66% and 100% with 1% alum solutions. Schootstra et al. reported good outcomes in patients with bladder haemorrhage after treating sixteen patients using 0.5% alum solution.[10] Nonetheless, intravesical alum instillation seemed to be effective, the most innocuous and inexpensive method with the least morbidity in both radiation cystitis and sloughing tumoral mass[19,22] Intravesical 1% alum in irrigation was also reported to represent an effective and well-tolerated option for patients with hemorrhagic cystitis associated with bladder carcinoma and irradiation.[23]

A 1% solution of alum also has been given to control bleeding from a rectal carcinoma.[24] On the other hand, there are possible side effects and complications after using alum. It is known that alum in salts can cause allergic reactions in susceptible individuals even after topical use.[20,25]
Encephalopathy and acute aluminum intoxication are also possible complications of using alum, they happened mainly in patients with impairment of renal function. [26 -28] Shoskes et al. reported the death of a patient with kidneys dysfunction, who was treated twice within a 3-month period using 1% alum given over 48 hours.[29] To avoid the systemic side effects in such situations, serum levels of aluminum can be measured during the treatment.

Wound healing is a physiological process that involves several overlapping stages. These stages could include inflammation, formation of granulation tissue, re-epithelialization, extra cellular matrix (ECM) formation and remodeling.[30] This experiment have demonstrated a better healing features in the form of tissue formation and re-epithelialization, an increased collagen distribution and deposition, and increased angiogenic marker in the healed tissue exposed to alum. These better healing characteristics will decrease the likelihood of developing complications related to the healing process like nasal septal perforation which is a well-known complication that may occur when using silver nitrate especially when it is used repeatedly or on both sides of the nasal septum at the same time.

The observations from this experiment also propose that alum possesses better efficiency to stop bleeding in a shorter

time in comparison to silver nitrate and this difference was statistically significant. Although the mechanism through which alum stops bleeding is not well clear, it is most likely secondary to its ability to precipitate proteins that fasten the formation of clots, and by causing constrictions of the bleeding vessels.

One of the limitations of this study is that it was done on animals, testing these findings on human subjects is necessary to confirm the outcomes seen in this study.

Another limitation is the small sample size, a larger number of subjects is necessary to make stronger conclusions.

This study should encourage further trials to confirm the objective of this study for treating a very common emergency in the field of otolaryngology, with a neatly faster, and more convenient method which will result in less morbidity.

Conclusion

This experiment showed that alum is a better alternative to silver nitrate in the treatment of a very common emergency in the field of otolaryngology. It represents a new option that is more efficient in controlling epistaxis in shorter time in comparison to silver nitrate, and with less risk for developing healing-related complications that could be encountered with using silver nitrate.

Conflict of Interest:

We declare no conflict of interest.

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