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EPISTAXIS AT PATAN HOSPITAL: A RETROSPECTIVE REVIEW AND AN AUDIT

Objective:

The objective of this study was to review the cases of epistaxis and audit its management at Patan Hospital.

Materials and Methods:

This was a retrospective study and an audit carried out in patients admitted for epistaxis in Patan Hospital from August 2012 to August 2014. All the patients with primary epistaxis were included. The data were analyzed in terms of the specific defined parameters and were compared with that of Guy's Hospital, United Kingdom, of year 2011.

Results:

Out of 146 patients, 111 had primary epistaxis. Ninety-three patients (83.78%) with primary epistaxis had anterior bleeding and 18 patients (16.21%) had posterior bleeding. The majority of the patients (31.53%) were treated with chemical cautery, followed by anterior nasal packing (27.02%). Eleven patients (10%) underwent sphenopalatine artery cauterization. The data of our hospital were optimal or near optimal in some aspects like documented initial nasal examination, and initial cautery attempt whereas, parameters like re-bleeding rate, surgical intervention and endoscopic nasal examination after cessation of bleeding were found to be sub-optimal.

Conclusion:

The improvements are required in some aspects of management of epistaxis like decreasing the re-bleeding rate, increasing the timely surgical intervention and compulsory endoscopic evaluation of nasal cavity after cessation of bleeding. This can be attained with adherence to the protocol as proposed. A multi-center audit would be required to develop a common consensus regarding its management.

Keywords: Epistaxis, Nasal packing, Surgery

INTRODUCTION:

Epistaxis is the commonest emergency in otolaryngology.¹ It affects 60% of population once in their lifetime and 6% of those affected require medical attention.² Most of the bleeding are mild and self-limiting. However, some are life threatening leading to significant morbidity and mortality and often create a challenging situation for the clinician. The several demographical and meteorological factors play role in the predisposition to the primary epistaxis. There have been recent advances in the management strategies of epistaxis. This is primarily due to the advent of the endoscopic technologies helping otorhinolaryngologists to manage bleeding efficiently with less morbidity. The use of endoscope enables clinicians to find the posterior bleeding points that cannot be identified with head light examination. The trend in the treatment of refractory epistaxis has shifted from the traditional repeated nasal packing to the identification and prompt ligation of the main arteries supplying the nasal mucosa avoiding the morbidity and prolonged hospital stay. The need for hospital admission and the duration of stay in the hospital are directly linked to the methods chosen for the initial and subsequent modalities of the treatment.³ The purpose of this study to review and audit the management of the patients admitted with primary epistaxis at Patan Hospital.

MATERIAL AND METHODS:

This was a retrospective study conducted at Department of ENT and HNS at Patan Hospital, Lalitpur, Nepal. In-patient records of the patients admitted with diagnosis of primary epistaxis from August 2012 to August 2014 were studied. The patients with secondary causes of epistaxis like trauma, coagulopathies, sinonasal tumors and other systemic illnesses were excluded from the

study. The retrospective study of the in-patient records was carried out for the analysis of the demographic profile. The presence of the risk factors like hypertension, alcohol dependence and use of anti-platelet agents were observed. The patients with alcohol dependence were also evaluated and treated by the psychiatrists. The records were scrutinized to study the overall management of the patients. The data were compared to that of the audit of Guy's Hospital,⁴ United Kingdom of year 2011. The data were analyzed in terms of specific audit parameters reflecting the quality of care with 100% target of compliance as given in Table 1. Re-bleeding rate was also observed and compared. The audit parameters are based on the study by Hall et al.^{4,5}

Tab. 1: Audit standards

Audit parameters	Target
Documented nasal examination	100
Initial attempt for nasal cautery, if appropriate	100
Surgical intervention, if appropriate	100
Endoscopic nasal examination, post cessation of bleeding	100

The nasal cautery was deemed appropriate in patients where the bleeding points could be identified with anterior rhinoscopy. The documented attempt of chemical cautery was considered as positive regardless of the outcome of the cautery. The surgical intervention was defined appropriate in cases of persistent bleeding for over 48 hours despite anterior or posterior nasal packing. The surgical interventions included endoscopic localization of the bleeding site and cauterization of the vessel of the origin (sphenopalatine or ethmoid vessel) or perform sphenopalatine artery cauterization if no definite vessel could be seen. This parameter shows the

standard of the management for the refractory epistaxis.

RESULTS:

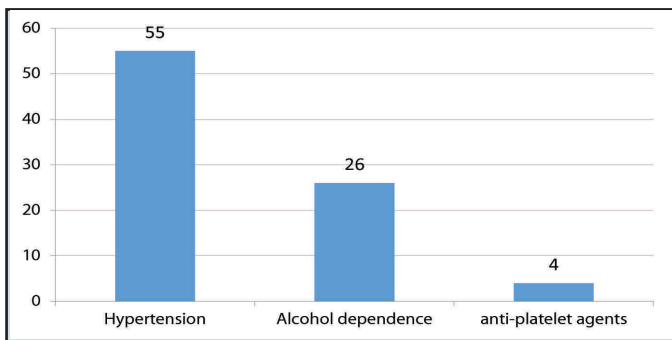
Patient demographics

Out of 146 patients admitted in the department of ENT at Patan Hospital, 111 patients (76.02%) had primary epistaxis. Out of 111 patients, 66 were male and 45 were female. The age ranged from 2 years to 90 years (mean age of 46 years) with highest number of incidence observed in the age group of 41 to 50 years.

Epistaxis risk factors

The prevalence of co-morbidities like hypertension, alcohol dependence and use of anti-platelet medicines were assessed, the finding of which is shown in Fig. 1. Among 55 patients with hypertension, 18 patients were not on any anti-hypertensives and 18 patients were newly diagnosed hypertensive. Out of 4 patients on anti-platelet medications, 2 were using aspirin 75 mg only and other 2 were taking both Aspirin 75 mg and Clopidrogel 75 mg. None of the patients were on any anticoagulants.

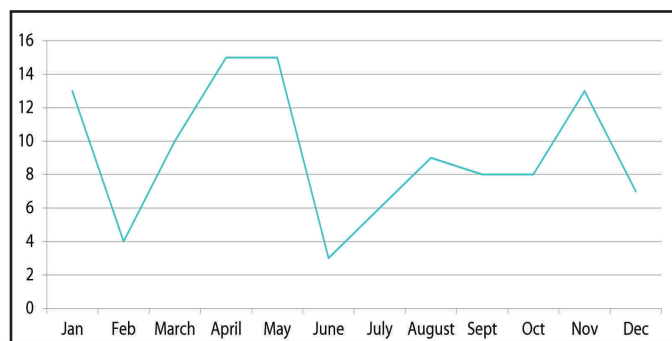
Fig. 1: Documented epistaxis risk factors



Seasonal variation

Fig. 2 shows the trend of epistaxis occurrence in relation with the season with highest peak incidence in month of April-May followed by second peak in November. The more detailed study of association of the incidence of epistaxis and factors like temperature and humidity is beyond the aim of this study

Fig. 2: Seasonal incidence of epistaxis



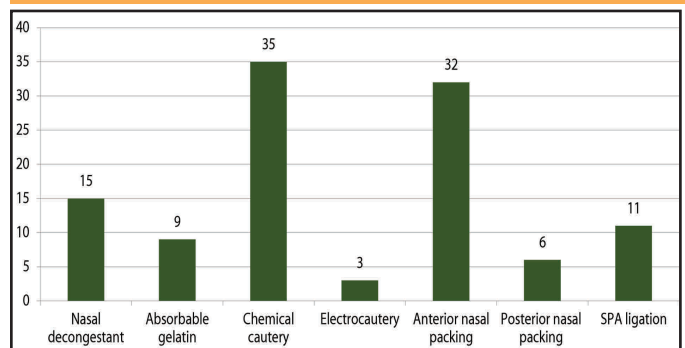
Documentation of nasal findings

The study showed 100% documentation of the nasal findings of the patients before packing. However, inadequate recording of the findings of endoscopic nasal examination or omission of the endoscopic examination itself after control of bleeding was observed. Only 68 in-patient records out of 111 (61.26 %) had documented nasal examination after control of bleeding.

Modalities of Treatment

Out of 111 patients, 93 (83.78 %) had anterior epistaxis and 18 (16.21%) had posterior epistaxis. Patients with anterior epistaxis were treated either with nasal decongestants, absorbable gelfoam, chemical cautery, electrocautery and anterior nasal packing. Posterior epistaxis was managed with either anterior or posterior nasal packing or with endoscopic Sphenopalatine artery ligation. Only one patient with posterior bleeding responded to anterior nasal packing with ribbon gauze. The majority of the patients (31.53%) were treated with chemical cautery after localization of the bleeding points. In three patients, chemical cautery was done as second intervention after failure to control the bleeding with anterior nasal packing. The patients treated successfully with chemical cauterization were generally discharged except the ones with co-morbidities or with higher risk of re-bleeding like elderly patients especially those residing in distant places. Anterior nasal packing (ANP) was the second most common modality of treatment for successful control of bleeding, used in 27.02% of patients. Among 32 patients treated with ANP, 20 patients were packed with ribbon gauze soaked in BIPP, 8 patients with Rapid Rhino and 2 patients with Merocel. Six patients were managed with posterior nasal packing (PNP) out of which 3 were done with posterior choanal gauze pack soaked in BIPP and 3 PNP with double balloon catheter. Eleven patients (10%) underwent surgical procedure of sphenopalatine artery ligation. Eight patients had this surgical procedure as a third line of treatment, among them 5 had undergone ANP twice and 3 patients had failed to respond to both ANP and PNP with gauze under general anaesthesia. Only 3 patients had artery ligation as a second line of treatment for re-bleeding. Only eight patients out of 11 had surgical intervention within 48 hours which excludes those treated initially with PNP. The overall procedures used for the management of epistaxis are depicted in Fig. 3.

Fig. 3: Modalities of treatment for epistaxis



Duration of stay

The length of stay varied greatly among the patients ranging from 1 day to 13 days (mean duration of 7 days). The average duration of stay was higher in recalcitrant patients managed either with posterior nasal packing only (6.6 days), sphenopalatine artery ligation only (6 days) or both (13 days). The epistaxis patients with alcohol dependence stayed further longer in psychiatry ward for the management of alcohol dependence.

Complications

No mortality was documented. Two complications each of septal perforation and vestibular stenosis occurred in two patients managed with posterior nasal packing with gauze.

Audit summary

The evaluation of the management of the epistaxis was also carried out based on the specific parameters as stated in Table 1 and was compared with that of audit findings of Guy’s Hospital. The audit findings are shown in the Table 2.

Tab.e 2: Audit summary

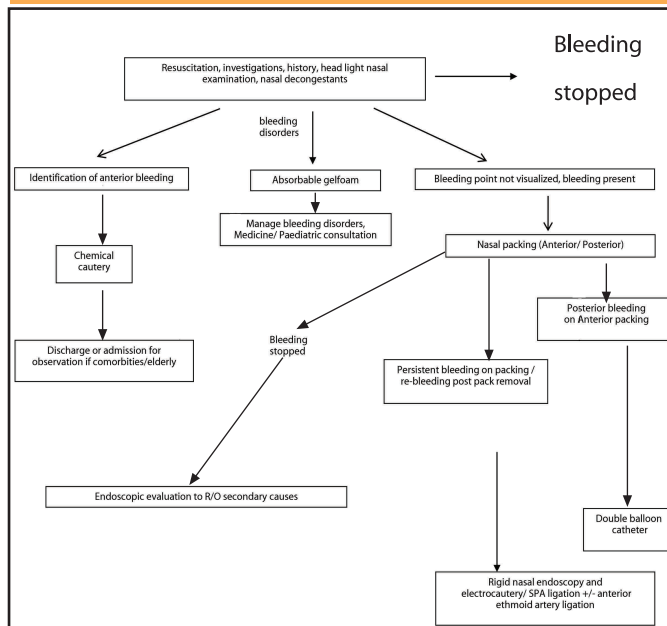
Audit parameters	At Patan Hospital (%)	At Guy’s Hospital (%)
Documented nasal examination	100	52
Initial attempt at nasal cautery (if appropriate)	32/35 x 100 = 91.4	52
Surgical intervention (if appropriate)	8/14 x 100 = 57.14	66
Re-bleeding rate	32/111 x 100 = 28.82	16
Documented endoscopic nasal examination post cessation of bleeding	68/111 x 100 = 61.26	78

The nasal examination was carried out in all the patients and was documented in all records by the residents on call. The initial attempt of chemical cautery was carried out in only 32 patients though three other patients seemed appropriate candidate as they required chemical cautery as a second intervention to control bleeding. Eleven cases underwent sphenopalatine artery ligation among which only 8 patients had this within 48 hrs. Three other patients despite of being appropriate candidate for arterial ligation due to persistent bleeding for 48 hours even after repeated anterior nasal packing were treated with posterior nasal packing with gauze under general anaesthesia. Thirty-two patients bled repeatedly following initial treatment and were either managed with anterior or posterior nasal packing or sphenopalatine artery ligation. Endoscopic nasal examination was documented in only 68 patients. The rest of patients were either not evaluated by nasal endoscopy after cessation of bleeding or the examination was not documented.

DISCUSSION:

Primary idiopathic epistaxis is more common than secondary epistaxis with definite cause. Seventy to eighty percent of all the cases of epistaxis are idiopathic, spontaneous bleeds.⁶ In our study 111 out of 146 patients (76.02%) had primary epistaxis. Male preponderance as mentioned in the literature was seen in our study with the male: female ratio of 1.46:1. The highest incidence was seen in the patients aged between 41 to 50 years. Fifty-five out of 111 patients (49.54%) with epistaxis were hypertensive. Despite this finding in our study, a number of large studies have failed to show a causal relationship between hypertension and epistaxis.^{7,8,9,10} It has also been suggested that hypertension does not cause epistaxis, rather prolongs it and its related to the lesions

Fig. 4: Treatment algorithm for our patients with epistaxis



of vascular endothelial, microcirculatory disorders, and modification of the blood coagulation processes rather than to the mechanical rupture of blood vessels.^{3,11} Even if not causal, the blood pressure is elevated in most of the patients with epistaxis which may be due to the anxiety associated with admission and other procedures used to control the bleeding.¹²

Twenty-six patients with epistaxis were alcohol dependent with elevated indirect blood markers like liver enzymes. The hemostasis in such patients is deranged due to the platelet dysfunction leading to prolonged bleeding time.¹³ In our study, only 4 patients were on antiplatelet medications that was not stopped throughout the treatment of epistaxis. A recent study in 10241 patients found that there is an increased risk of troublesome epistaxis in patients taking aspirin or clopidogrel, but there is no significant difference in risk of epistaxis between the two drug groups.¹⁴ Walker et al had proposed a protocol for the management of epistaxis in patients taking such drugs which states that aspirin or clopidogrel can be continued except in cases of life-threatening bleeding when platelet transfusion can be considered.¹⁵ The routine coagulation studies in epistaxis patients are only recommended in cases with history of alcohol or drug use and bleeding disorders.^{16,17}

The epistaxis was more common in the months of April and May and least common in month of June. This could be due to the highest temperature in the April/May and highest humidity due to rainfall in June. Most of the literatures show strong seasonality of epistaxis with peak during winter^{18,19,20}. Jelavic et al. found seasonal variation with an incidence peak during the spring transition months in Mediterranean climate.²¹ However, some authors do not support the view that there is a relationship between epistaxis and temperature or seasonal variation.²²

The initial head light nasal examination is very important aspect to be missed as it helps to establish the line of management by deciding whether the bleeding is from anterior or posterior site. The documentation is equally important for the medicolegal issues if arise. This parameter is optimal in our center as our junior residents are properly trained to perform them with conceptual understanding unlike in the Guy's hospital where the cases of epistaxis are evaluated initially by doctors working in other departments like surgery, orthopedics and covering the ENT specialty as a part of the hospital night rota. Between 90 to 95 percent of the epistaxis are anterior with majority of them arising from the little's area.¹ Our study had 83.78% of patients with anterior bleeding point. In such patients, either chemical or electrocautery can be done to stop the bleeding once the bleeding point is identified. Posterior epistaxis is more complicated as it is difficult to identify the bleeding point with simple head light examination. The first priority in such cases is to control the bleeding by the use of nasal packing. The use of cauterization blindly is not advocated.²³ Nasal packing, both anterior and posterior, used to be done traditionally with gauze soaked with Bismuth Iodoform Paraffin Paste (BIPP) or antibiotic ointment. The effective nasal packing with gauze requires some expertise and is traumatic to the patient. The traditional posterior nasal packing with gauze requires general anaesthesia. Nowadays, we have varieties of commercially prepared packs that are easy to insert and are less traumatic for patients. Material like Merocel provide tamponade effect as it expands on coming in contact with blood whereas Rapid Rhino is inflatable balloon coated with a carboxymethylcellulose hydrocolloid compound that acts as platelet aggregator. On the other hand, double balloon catheter has two inflatable balloons for both anterior as well as posterior nasal cavity. A prospective randomized trial involving 50 patients with severe epistaxis compared Merocel tampons with traditional anterior nasal packing with ribbon gauze soaked in Bismuth Iodoform Paraffin Paste. No difference was found with regard to efficacy or patient tolerance.²⁴ Rapid Rhino was compared with Merocel for the treatment of anterior epistaxis not amenable to treatment with cautery. No difference was found in the rate of control of epistaxis though the insertion and removal of Rapid Rhino was found to be easier.²⁵

There is scarce literature comparing different types of posterior packing. In a study by Callejo et al., classic gauze packing was found to be time taking and uncomfortable when compared to the double chambered pneumatic packing device, however, was less expensive with low re-bleeding rate.²⁶ The success rate of posterior packing has been quoted in literature as of 70% only.²⁷ Posterior packing is associated with a set of complications like alar, columellar or septal necrosis, infectious complications and naso-vagal reflex causing cardiac dysfunction or respiratory arrest. In our study also, septal perforation and vestibular stenosis were encountered in patients treated with posterior nasal packing with gauze. A major advance in the management of posterior epistaxis is the advent and popularization of techniques of endoscopic ligation or cautery of sphenopalatine artery

(ESPAL).¹ This is due to better understanding of loco-regional anatomy and acceptance of the sphenopalatine artery as a significant distal supply for the major part of the nose. A systematic review by Kumar et. al, in a pooled series of 127 patients showed that ligation of SPA and cautery were efficacious in 98% and 100%, respectively.²⁸ Re-bleeding after ESPAL is attributed to multitude of factors like clip dislodgement, presence of rich collateral vessels, failure of identification and clipping of all the branches.²⁹ ESPAL can also be combined with anterior ethmoid artery ligation if a superior bleeding source is clinically suspected. The surgery is shown as the most cost effective and least painful treatment regimen for posterior epistaxis with shorter hospital stay and is regarded safe in the pediatric population.^{30,31,32,33,34} Abdelkader et al did a prospective audit of endoscopic sphenopalatine artery ligation on 43 patients and recommended that it should be the second line treatment for posterior epistaxis when the first attempt of conservative management fails.²⁹ In our study, total of six patients underwent posterior nasal packing, with three re-bleedings that were later controlled with SPA ligation. The average duration of stay in these patients who had to undergo ESPAL as the end stage treatment post failure of posterior nasal packing (13 days) was higher than those treated with SPA ligation alone (6 days). The posterior epistaxis usually occurs often in elderly, frail and with multiple concomitant medical problems. Therefore, inclusion of early surgical intervention in the algorithm for intractable epistaxis has been suggested.^{35,34} Some authors even recommend the use of ESPAL as a first option, without waiting for the failure of the posterior packing.^{32,36} In some centers, patients presenting with posterior epistaxis are treated primarily with ESPAL under local anesthesia with mild sedation and discharged on same day.³⁷ In our hospital, with the availability of expertise in endoscopic nasal surgery, we have been routinely practicing sphenopalatine artery cauterization in recent years. Embolization is also an accepted treatment modality for posterior epistaxis, where available. The success rate is quoted in the literature as to be 79% to 96%.³⁸ However, the technique is twice as costly as surgical treatment and carries risks like blindness, facial numbness, carotid artery dissection and groin hematoma^{34,37}. Embolization requires expert like interventional radiologist and is not feasible in our center because of the lack of such resource.

The surgical intervention rate is just more than half of the optimal in our center. Persistent and repeated packing is seen to have occurred in some of the refractory cases. The repacking in such cases should be discouraged and we need to consider arterial cauterization early. In addition, high rate of re-bleeding is quite concerning. It needs to be minimized with appropriate measures depending upon the site of the bleeding at the right time. The sub-optimal initial attempt at cautery may be due to the difficulty to identify the site and lack of appropriate decision making by the residents on call. The optimization of all these audit parameters can be achieved by establishing a treatment protocol. We believe to improve the quality of treatment and standard of care by adhering to the the protocol given in Fig.4 that guides all the

clinicians at various level involved in the management of the patients. The proposed protocol is based on the one adopted at Guy's Hospital⁴.

The traditional approach to manage patients with intractable epistaxis is to rely on surgery as a last line of treatment once all conservative treatments have failed. The proposed treatment algorithm discourages repeated nasal packing and advocates earlier deployment of surgical procedures. The sphenopalatine artery ligation may or may not be accompanied with anterior ethmoid artery ligation according to the site of bleeding.

CONCLUSION:

This study shows that our department is practicing the current standard of treatment for the epistaxis though some improvements are needed to achieve the best. It is expected to improve with the strict adherence to the protocol. This study was done in a single hospital setting. Variability of practice is obvious in the management of epistaxis among various hospitals in our country. A multi-center audit would be much better to improve the standard of care and gain a consensus regarding the treatment for such a common ENT emergency.

Compliance with ethical standards

There are no potential conflicts of interest among the authors. The consent was taken from Institutional Review Board of Patan Academy of Health Sciences.

REFERENCES:

- Douglas R, Wormald PJ. Update on epistaxis. *Current Opinion in Otolaryngology & Head and Neck Surgery* 2007;15(3):180-3.
- Small M, Murray JAM, Maran A.G.D. A study of patients with epistaxis requiring admission to hospital. *Health Bulletin* 1982;40:20-9.
- Melia L, McGarry GW. Epistaxis: update on management. *Current Opinion in Otolaryngology & Head and Neck Surgery* 2011;19(1):30-5.
- Hall AC, Simons M, Pilgrim G, Theokli C, Roberts D, Hopkins C. Epistaxis management at Guy's Hospital, 2009-2011:full audit cycles. *The Journal of Laryngology & Otology* 2014; 128:82-5.
- Hall AC, Blanchford H, Chatrath P, et al. A multi-centre audit of epistaxis management in England: is there a case for a national review of practice? *The Journal of Laryngology & Otology* 2015;129:454-7.
- Stell PM. Epistaxis. *Clinical Otolaryngology*. 1977; 2:263-73.
- Lubianca-Neto JF, Fuchs FD, Facco SR, et al. Is epistaxis evidence of end-organ damage in patients with hypertension? *Laryngoscope* 1999;109:1111-5.
- Page C, Biet A, Liabeuf S, et al. Serious spontaneous epistaxis an hypertension in hospitalized patients. *Eur Arch Otorhinolaryngol* 2011;268(12):1769-53.
- Fuchs FD, Moreira LB, Pires CP, et al. Absence of association between hypertension and epistaxis: a population-based study. *Blood Press* 2003;12(3):145-8.
- Knopfholz J, Lima-Junior E, Precoma-Neto D, Faria-Neto JR. Association between epistaxis and hypertension: a one year follow-up after an index episode of nose bleeding in hypertensive patients. *Int J Cardiol* 2009;134(3):107-9.
- Boiko NV, Shatokhin YV. Pathogenesis of nasal bleeding in the patients presenting with arterial hypertension. *Vestn Otorinolaryngol* 2015;80(5):41-5.
- McGarry GW. Epistaxis. In: Gleeson M, editor. *Scott-Brown's Otorhinolaryngology, Head and Neck Surgery*. 7th ed. London: Edward Arnold; 2008. P. 1596-1608.
- McGarry GW, Gatehouse S, Vernham G. Idiopathic epistaxis, haemostasis and alcohol. *Clinical Otolaryngology*. 1995;20:1747.
- Rainsbury JW, Molony NC. Clopidogrel versus low-dose aspirin as risk factors for epistaxis. *Clin Otolaryngol* 2009;34:232-5.
- Walker FDL, Rutter C, McGarry GW. The use of anticoagulants in epistaxis patients. *Rhinology* 2008;46:346.
- Padgham N. Epistaxis: anatomical and clinical correlates. *J Laryngol and Otol*. 1990; 104:308-11.
- Smith IM, Ludlam CA, Murray JAM. Haematological indices in elderly patients with epistaxis. *Health Bulletin*. 1988;46:277-81.
- Ivan C, Vincenzo V, Mario B, et al. Influence of air temperature variations on incidence of epistaxis. *American Journal of Rhinology and Allergy* 2015;29(6):175-81.
- Nunez DA, McClymount LG, Evans RA. Epistaxis: a study of the relationship with weather. *Clin Otolaryngol Allied Sci* 1990;15(1):4951.
- Danielides V, Kontogiannis N, Bartzokas A, et al. The influence of meteorological factors on the frequency of epistaxis. *Clin Otolaryngol Allied Sci* 2002;27(2):84-8.
- Jelavic B, Majstorovic Z, Kordic M, et al. Idiopathic epistaxis and meteorological factors: case-control study. *B-ENT* 2015;11(4): 267-73.
- Bray D, Giddings CE, Monnerly P, et al. Epistaxis: are temperature and seasonal variations true factors in incidence? *J Laryngol Otol* 2005;119(9):724-6.
- Hill SC, Hughes O. Update on management of epistaxis. *The West London Medical Journal*. 2009;1:33-41.
- Corbridge RJ, Djazaeri B, Hellier WPL, et al. A prospective randomized controlled trial comparing the use of Meroceol nasal tampons and BIPP in the control of acute epistaxis. *Clin Otolaryngol* 1995;20:305-307.
- Malik BK, Belloso BA, Timms MS. Randomized controlled trial comparing Meroceol and Rapid Rhino packing in the management of anterior epistaxis. *Clin Otolaryngol* 2005;30:333-337.
- Garcia Callejo FJ, Munoz Fernandez N, Achiques Martinez MT, et al. Nasal packing in posterior epistaxis. Comparison of two methods. *Acta Otorrinolaryngol Esp* 2010;61:196-201.
- Massik D, Tobin EJ. Epistaxis. In: Cummings CW, Haughey BH, Thomas JR, et al, editors. *Cummings otolaryngology: head and neck surgery*. Philadelphia: Mosby; 2005. p. 942-61.
- Kumar S, Sheety A, Rockey J, Nilssen E. Contemporary surgical treatment of epistaxis. What is the evidence for sphenopalatine artery ligation? *Clin Otol* 2003;28:360-363.
- Abdelkader M, Leong SC, White PS. Endoscopic control of sphenopalatine artery for epistaxis: long-term results. *The journal of laryngology and otology* 2007;127:759-762.
- Nikolaou G, Holzmann D, Sokya MB. Discomfort and costs in epistaxis treatment. *Eur Arch Otorhinolaryngol* 2013;270:2239-44.
- Eladl HM, Khafagy YW, Abu-Samra M. Endoscopic cauterization of the sphenopalatine artery in pediatric intractable posterior epistaxis. *Int J Pediatr Otorhinolaryngol* 2011;75:1545-8.
- Dedhia RC, Desai SS, Smith KJ, et al. Cost-effectiveness of endoscopic sphenopalatine artery ligation vs. nasal packing as first-line treatment for posterior epistaxis. *Int Forum Allergy Rhinol* 2013;3:563-6.
- Srinivasan V, Sherman IW, O'Sullivan G. Surgical management of intractable epistaxis; audit of results. *J Laryngol Otol* 2000; 114:687-700.
- Miller TR, Stevens ES, Orlandi RR. Economic analysis of the treatment of posterior epistaxis. *Am J Rhinol* 2005;19:79-82.
- Koltz DA, Winkle MR, Richmon J, Hengerer AS. Surgical management of posterior epistaxis: a changing paradigm. *Laryngoscope* 2002;112:1577-82.
- Agreda B, Urpegui A, Alfonso I, Valles H. Ligation of the sphenopalatine artery in posterior epistaxis. Retrospective study of 50 patients. *Acta Otorrinolaryngologica Espanola* 2011;62:194-8.
- Gifford TO, Orlandi RR. Epistaxis. *Otolaryngol Clin of N Am* 2008;41:525-36.
- Smith TO. Embolization in the external carotid artery. *J Vasc Interv Radiol* 2006;17(12):1897-92.