Recent Trends in Epistaxis Management in the United States 2008-2010

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**IMPORTANCE** The treatment of epistaxis is variable. It is important to analyze the effect of the available interventions on patient outcomes.

**OBJECTIVE** To determine demographic, management, and outcome trends in patients admitted with a primary diagnosis of epistaxis and treated with conservative management, nasal packing, arterial ligation, or embolization.

**DESIGN, SETTING, AND PARTICIPANTS** A review of the data reported by hospitals to the 2008-2010 Nationwide Inpatient Sample for patients admitted with a primary diagnosis of epistaxis was conducted.

**INTERVENTIONS** Conservative management, nasal packing, arterial ligation, or embolization for epistaxis control.

**MAIN OUTCOMES AND MEASURES** Descriptive statistics for hospital and patient demographic data. Multivariate models were constructed to compare treatment modalities, controlling for patient- and hospital-level variation while reporting the treatment outcomes of mortality, stroke, blindness, length of stay, and total cost. Comparisons were made between patients undergoing embolization, surgical ligation, or nasal packing. Descriptive statistics for patients treated conservatively are reported.

**RESULTS** A total of 57,039 cases of primary epistaxis were identified. Of these, 21,872 patients (38.3%) were treated conservatively, 30,389 (53.3%) received nasal packing or cauterization, 2706 (4.7%) underwent arterial ligation, and 1956 (3.4%) underwent embolization. The odds of stroke in patients following embolization were significantly higher than in patients who underwent nasal packing (odds ratio, 4.660; \( P = .003 \)), with no significant difference seen compared with surgical ligation (\( P = .70 \)). There were no significant differences in the odds of mortality or blindness between any of the study groups. Patients undergoing embolization incurred the highest total hospital costs, nearly doubling the cost of ligation (\( P < .001 \)), without a corresponding increase in the length of hospital stay (\( P = .20 \)).

**CONCLUSIONS AND RELEVANCE** Treatment for epistaxis is highly variable. No significant differences in clinical outcomes were noted between arterial ligation and embolization in the population studied, although embolization resulted in significantly higher costs. Further prospective studies are needed to elucidate variables affecting outcomes of the various treatment options for epistaxis.

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approximately 60% of the general population will experience an episode of epistaxis in their lifetime, with causes ranging from idiopathic to cancerous lesions.\(^1,2\) Seventy percent of epistaxis cases occur spontaneously.\(^1\) Approximately 6% of patients presenting with epistaxis ultimately require medical or surgical intervention, and less than 0.2% require hospitalization due to epistaxis.\(^1,2\)

Most epistaxis (approximately 90%) arises from the Little area along the caudal septum. Blood supply to this area is from the Kiesselbach plexus, which is composed of second-order branches of the internal and external carotid artery systems. Hemorrhage here, commonly referred to as anterior epistaxis, often can be managed conservatively.\(^1\) Epistaxis originating from more posterior aspects of the nasal cavity is referred to as posterior epistaxis. Posterior epistaxis accounts for only 5% to 10% of cases.\(^3\) More conservative management of posteriorly based nasal hemorrhage, including nasal packing, is less successful, ranging from 48% to 83%. For this reason, posterior epistaxis has historically been treated via an open or endoscopic surgical approach with direct cauterization or ligation of the involved artery.\(^1\) A review by Soyka et al\(^5\) reported a success rate of 97% for surgical treatment of posterior epistaxis.

Endovascular approaches are a viable alternative to surgical intervention for life-threatening nasal hemorrhage, with overall reported success rates of 71% to 100%.\(^1,2,20\) Complications of endovascular embolization are usually minor, including sinusitis, septal perforation, otitis media, facial pain, headache, jaw pain, and facial edema or numbness.\(^2\) Major complications, however, can occur. These result from inadvertent embolization and include stroke, blindness, facial nerve paresis, and soft-tissue necrosis.\(^5,20,21\) Notably, these complications are rarely encountered with packing or ligation. Embolization failure is often related to continued bleeding from the ethmoidal branches of the ophthalmic artery. This presents a problematic area with the risk of retrograde ophthalmic embo-
lization and resultant blindness. Continued bleeding following embolization necessitates surgical ligation, often of the anterior and posterior ethmoid arteries.\(^7\) Overall, however, success and complication rates are comparable between surgical ligation and embolization.\(^1,3,20,21\)

Reports\(^2,3,6,7\) of treatment outcomes, length of stay, and cost of admission and treatment with different epistaxis management strategies are variable. Our objective was to compare clinical endpoints, including mortality and the incidence of stroke and blindness, as well as economic endpoints, including hospital costs and the length of stay, between patients with a primary diagnosis of epistaxis treated with embolization, ligation, and packing. Additionally, we examined demographic data for patients admitted with a primary diagnosis of epistaxis and provide descriptive statistics for the population of patients without intervention.

### Methods

Discharge data from the Nationwide Inpatient Sample (NIS), Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality, were analyzed. This database represents approximately a 20% sample of US hospitals. Detailed information on the design of the NIS is available at www.hcup-us.ahrq.gov. Data from calendar years 2008, 2009, and 2010 were included in the present study. Total hospital charges from 2008 and 2009 were compounded yearly at an inflation rate of 3% to standardize charges at 2010 levels. Hospital charges were converted to costs using the group average all-payer inpatient cost to charge ratio. All cases with epistaxis as the primary admitting diagnosis were included (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM], diagnosis codes 784.7 and 478.29). Separate subgroups for analysis were then created based on treatment received during admission. The groups, with respective ICD-9-CM procedure codes, were as follows:

3. Endovascular embolization: occlusion head/neck vessel not elsewhere classified and surgical vessel occlusion not elsewhere classified (39.72, 38.82, 38.80, and 39.79).

Patients receiving a combination of ligation and embolization were excluded from analysis because they had more complicated management and their hospital outcomes are not reflective of a specific procedure. Hospital and patient demographic data were evaluated. The method of comorbidity extraction using inpatient data sets has been described and validated previously.\(^8\) The incidence of serious procedural complications, including stroke and blindness, were assessed by searching secondary diagnoses codes for 39.74, 436, 997.02, and 369.60, 369.67, and 950.09 (blindness).

### Statistical Analysis

Data were analyzed using commercial software (SPSS, version 17; IBM Corp). To obtain national estimates, discharge weights were applied. All statistical comparisons were performed between the nasal packing, embolization, and surgical ligation groups. Only descriptive statistics are provided for the group of patients whose treatment was managed conservatively because of a presumed difference in epistaxis severity between the treatment and nontreatment groups. Study variables were compared using \(\chi^2\) tests, Fisher exact tests, and independent-samples \(t\) tests. Two-tailed probabilities less than .05 were considered significant.

To account for hospital- and patient-level variation in outcome measures, multivariate models were used to compare interventions for epistaxis. This allows comparison while adjusting for confounding variables included in the NIS data set. The analysis was adjusted for the following patient-specific factors: age, sex, race, number of chronic conditions, number of...
The purpose of this study was to examine demographics and discharge-level outcomes from a nationwide inpatient database to identify current trends in epistaxis management. In addition, multivariate models were constructed to examine outcomes while controlling for patient- and hospital-level variation.

In agreement with the classic risk factors for epistaxis, the present study also saw an increased incidence of hypertension and coagulopathy in patients admitted with a primary diagnosis of epistaxis. Whether the diagnosis of hypertension alone or comorbidities requiring treatment with antithrombotic agents may be the cause of this association cannot be elucidated from the current data. The same holds true for patients with peripheral vascular disorders and congestive heart failure, which often are associated with hypertension and other cardiovascular disorders requiring treatment with antithrombotic agents. Other disease states seen more often in patients admitted for epistaxis than in the general population included atrial fibrillation, valvular heart disease, alcohol abuse, liver disease, renal failure, rheumatoid arthritis, and lymphoma. Overt hypothyroidism has been linked to an increased risk of bleeding. This study demonstrates a significant association between hypothyroidism and admission for epistaxis, supporting these previous reports.

Of the patients admitted with a primary diagnosis of epistaxis, 38.3% were treated conservatively. Anecdotally, this may seem like a disproportionately high number, especially when similar studies have not reported on a conservative management group. A likely explanation is that this cohort of patients may have undergone initial intervention without a corresponding ICD-9-CM code. This could include placement of nasal tampons, nasal balloon packing, or the application of silver nitrate cautery, which are commonly used techniques in the treatment of epistaxis.

The total charges for all treatment groups, including conservative management alone, have increased in comparison to the charges observed in prior research, despite no significant changes in length of stay. Of particular interest is the drastic and disproportionate increase in the cost of embolization. The average prior charges for embolization was $17,517 from 1998 to 2000. A decade later this had increased by an astonishing 345%, vastly outpacing inflation. This may be partly the result of the prior study’s inclusion of ICD-9-CM 88.41 (contrast cerebral angiogram), which may have been purely diagnostic without the deployment of embolization material.

The adjusted length of stay depicted no significant difference between intervention modalities. Patients undergoing ligation or embolization likely have a more severe and refractory nature of their disease. Intuitively, it seems that this should translate into an increased length of stay. However, prior studies, including one small prospective study, have shown that operative or endovascular control actually results in significantly shorter lengths of stay. Although not statistically significant, we also saw a decrease in adjusted length of stay for patients undergoing embolization.

diagnoses, number of procedures, annual patient income (<$39,000, $39,000-$47,999, and ≥$48,000), and payer (Medicare, Medicaid, private insurance, self-pay, or no charge). The analysis was also adjusted for hospital-level factors including: region (Northeast, Midwest, South, and West), teaching status, hospital bed-size (small, medium, and large), hospital location (rural or urban), and ownership of hospital (public, private nonprofit, private for profit). Generalized linear models were used to analyze the outcome measures. Estimated marginal means were used to make inferences on the continuous variables including the length of stay and cost. The effect ratio was expressed as the quotient of the estimated marginal mean for embolization or ligation over the estimated marginal mean for cases treated with packing. Bonferroni multiple comparisons were used to compare interventions. The binary outcomes—mortality, stroke, and blindness—were analyzed in binary logistic regression. Odds ratios and their 95% CIs are reported.

Results

The national incidence of patients admitted with a diagnosis of primary epistaxis from 2008 to 2010 was 57,039 cases. Of these, 116 patients underwent both surgical ligation and embolization procedures and, as such, were excluded from analysis. Subjects with a primary admission diagnosis of epistaxis had a mean age of 64.7 years, and a sex distribution of 47.6% female and 53.4% male. Patient and hospital demographics by intervention modality are presented in Table 1. Of note, the sex distribution was consistent across treatment groups with the exception of a disproportionately large number of men (64.0%) undergoing embolization. The embolization group also had fewer comorbidities and higher median income. An increased incidence of multiple comorbid conditions was found in patients admitted with epistaxis. Comorbidities are reported in Table 2.

To make valid inferences about the effect of intervention on the outcome measures (in-hospital mortality, stroke, blindness, length of stay, and hospital charges), we used multivariate models to adjust for hospital- and patient-level variation (Table 3). There was no significant influence of intervention modality on the odds of mortality or blindness. Embolization resulted in significantly increased odds of stroke vs nasal packing (odds ratio, 4.660; P = .003) but not in comparison with surgical ligation (P = .70). Patients treated with embolization incurred an increase in hospital costs by 93% in comparison with ligation, and a nearly 2.5-fold increase with reference to packing (P < .001). In contrast to the significant difference in length of stay documented in univariate analysis, the adjusted length of stay was nearly equivalent for all modalities, with embolization achieving the shortest hospital stay (P = .20).

Discussion

The purpose of this study was to examine demographics and discharge-level outcomes from a nationwide inpatient data-
EmboliZation provides several benefits including effective treatment of otherwise intractable posterior epistaxis. Based on the location of the bleeding, vessels such as the distal internal maxillary artery and the sphenopalatine artery can be targeted. Additionally, selective embolization is highly effective, with previously reported success rates ranging from...
73% to 100%.1-19 It is difficult to draw conclusions on the rationale for embolization in the patient population analyzed in the present study. According to the limited NIS variables describing the demographics for patients receiving embolization, they had the fewest chronic conditions, fewest recorded diagnoses, greatest median income, and the lowest all-patient refined diagnosis related group risk of mortality.

Also, patients undergoing embolization were disproportionately admitted to teaching hospitals, where interventional radiologists may be more accessible, in comparison with the other interventional groups. Literature1,4,17 largely reports equivalent success and complication rates between endovascular embolization and surgical ligation, and our study supports this finding.

The posttreatment rate of mortality and blindness observed in the present study population are comparable to the values reported by Goddard and Reiter19 regarding epistaxis. Prospective examination of epistaxis management would best identify case-specific outcomes that may significantly increased odds of mortality or blindness. Our finding of increased odds of stroke in patients undergoing embolization compared with nasal packing is in contrast to the 0% stroke rate noted by Goddard and Reiter. The limited use of embolization during their study (n = 94/978) may reflect a more stringent patient selection process compared with current management strategies. Also, the increased risk of stroke in our patient population may be related to the severity of epistaxis and possible resultant hypovolemia rather than as a direct consequence of the embolization. This is further supported by the fact that no significant difference in stroke rate was seen between patients who underwent surgical ligation vs endovascular embolization. Patients undergoing either of these interventions are likely to have more severe or intractable epistaxis compared with patients undergoing nasal packing alone. Further data are needed to determine whether the increased incidence of stroke seen in patients undergoing embolization is directly related to the intervention.

Because of limitations in the NIS, the outcomes measures of the present study are limited and do not include specific assessment for intervention success. Additionally, the site and severity of the epistaxis (ie, if the bleeding is visible on anterior rhinoscopy or from a specific artery) is unable to be elucidated in the studied patients. The NIS database does not afford this level of individualized data. Similarly, it is impossible to ascertain factors that play a role for the clinician determining a patient’s treatment course, such as anesthetic risk or bleeding severity. The data collected from the NIS do not take into account the clinical acumen of the physician or the myriad of individual factors that play into the determination of epistaxis treatment. The data provided, such as disease-related severity and number of comorbid conditions, are instead used as a rough proxy.

An additional limitation is the analysis of patients who underwent multiple interventions. Unfortunately, this information is difficult to extract from the NIS database. Not all participating hospitals report the specific timing of a given intervention. Additionally, for many of the cases, multiple procedures were coded as occurring on the same day. In this situation it is impossible to know which procedure occurred first, so it cannot be determined with confidence which procedure failed.

The exact procedural and periprocedural complications directly arising from a specific intervention are also not known. Because of the anonymity of the NIS database, it is unknown whether any of the cases presented repeatedly with unresolved epistaxis. Prospective examination of epistaxis management would best identify case-specific outcomes that may
better reflect the effectiveness of specific interventions. However, that was not the intent of the present analysis. This study sought to examine discharge-level outcomes to provide an overview of the current trends in epistaxis management.

Conclusions

The purpose of this study was to ascertain demographic and outcome differences among patients admitted with a primary diagnosis of epistaxis and receiving treatment in the form of nasal packing, arterial ligation, or endovascular embolization. The incidence of mortality and blindness was not significantly different between intervention modalities. The odds of stroke were significantly increased for patients receiving embolization compared with nasal packing, but this may be reflective of disease severity rather than procedural complications.

Total hospital costs were significantly increased for patients undergoing embolization without an accompanying increase in length of stay compared with ligation and packing. Because epistaxis treatment algorithms remain variable, further prospective studies are needed to elucidate variables affecting outcomes of the various treatment options for epistaxis.

REFERENCES