ORIGINAL RESEARCH



Factors associated with definitive observation unit care in patients with non-traumatic epistaxis: a retrospective observational study

Dong Ki Kim^{1,†}^o, Chung Man Sung^{2,†}^o, Jin Hyeok Park³^o, Sung Min Lee^{4,*}^o, Hyung Chae Yang^{2,*}^o

¹Department of Emergency Medicine, Chonnam National University Hospital, 61469 Gwangju, Republic of Korea ²Department of Otolaryngology-Head and Neck Surgery, Chonnam National University Medical School and Chonnam National University Hospital, 61469 Gwangju, Republic of Korea ³Department of Biology, Temple University, Philadelphia, PA 19122, USA ⁴Department of Emergency Medicine, Chonnam National University Medical School and Chonnam National University Hwasun Hospital, 58128 Hwasun, Republic of Korea

*Correspondence

em00058@jnu.ac.kr (Sung Min Lee); blessed@jnu.ac.kr (Hyung Chae Yang)

[†] These authors contributed equally.

Abstract

Epistaxis is one of the common causes of emergency department (ED) visits. However, most cases are not severe and undergo an unnecessary medical evaluation, especially in non-traumatic epistaxis. This study investigated how many patients require a definite observational unit (DOU) and what factors are associated with DOU among nontraumatic epistaxis patients. This retrospective observational study included 1197 nontraumatic epistaxis patients who visited the ED from January 2016 to December 2020. Multiple logistic regression analysis was performed to evaluate the association between risk factors and DOU care. In addition, the receiver operating characteristic (ROC) curve for predicting DOU care was analyzed to estimate the diagnostic ability of risk factors. A total number of 1122 patients with non-traumatic epistaxis were included in the final analysis. Among them, 41 (3.65%) patients needed DOU care. Male sex (odds ratio (OR) = 3.606, p = 0.003, hypertension (OR = 2.362, p = 0.020), inter-hospital transfer (OR = 2.358, p = 0.039), verbal mental status (OR = 29.436, p = 0.035), hemoglobin (Hb) level (OR = 0.724, p < 0.001), revisit after initial discharge for epistaxis (OR = 8.813, p < 0.001), and delayed ED arrival ($\geq 180 \text{ min}$) (OR = 2.451, p = 0.030) were significant factors for DOU care. In addition, the area under the curve of the multiple logistic regression model for predicting DOU care was 0.870. Among the patients who visited ED due to non-traumatic epistaxis, only 3.65% of patients required DOU care. Male sex, mental status, Hb level, ED revisit after initial discharge, inter-hospital transfer and delayed ED arrival (>180 min) were associated with DOU care. These findings will help to triage epistaxis patients before they visit the ED.

Keywords

Epistaxis; Emergency care; Risk factor; Hospitalization; Health resources

1. Introduction

Acute epistaxis is common and is one of the common causes of emergency department (ED) visits [1-4]. In the United States, more than 60% of the population experiences epistaxis. Epistaxis also accounts for 0.46 to 3.71% of patients visiting the ED [4-6]. While most patients can be discharged after basic hemostasis treatment, such as anterior nasal packing, up to 6% of epistaxis cases could be fatal and require monitoring at a definite observational unit (DOU) or in an Intensive Care Unit (ICU) [4]. Therefore, epistaxis should be addressed, and additional information is necessary for accurate triage.

In Korea, the primary medical staff in the ED coordinates with the otolaryngology department in treating epistaxis. In 2020, 22.76 per 10,000 people visited hospitals due to epistaxis [7]. As previously mentioned, most patients with epistaxis do not require intensive, multidisciplinary care. Only a few experienced life-threatening blood loss that requires DOU care [8, 9]. However, the extent of the care provided largely depends on the experience level of individual medical staff, as there is no triage protocol or clinical guideline for patients with non-traumatic epistaxis.

Since most non-traumatic epistaxis patients do not require intensive management, medical resources must be adequately redistributed between patients requiring simple hemostasis and those needing DOU. Triage is required to manage nontraumatic epistaxis in the ED efficiently. However, clinical guidelines are not currently established for managing nontraumatic epistaxis patients. We hypothesized that specific clinical and patient characteristic factors are associated with the need for definitive observational unit care in non-traumatic epistaxis patients. These factors can be used to predict which patients require specific care in the ED and result in improved patient outcomes and healthcare efficiency. Therefore, we analyzed the characteristics of patients with non-traumatic epistaxis who visited the ED. Among these patients, we analyzed prognostic factors related to patients who received DOU care.

2. Method

2.1 Study design and population

This investigation was a retrospective, observational study performed *via* chart review at a single academic tertiary care center with an annual ED census of 45,000 patients. This study was conducted on patients with non-traumatic epistaxis who visited the ED between January 2016 and December 2020. The sample size was based on a priori power calculation [10, 11]. Adults over 18 years of age were included. Patients with bleeding due to malignant tumors and hematologic diseases were excluded from the study. Patients with missing medical records were also excluded.

2.2 Treatment protocols

All patients in this study were treated similarly. When a patient visited ED, the primary medical staff in the ED performed anterior nasal packing. After checking the vital signs (blood pressure, heart rate, oxygen saturation, body temperature), medical history was taken. Around the same time, blood sampling for the laboratory blood tests (complete blood count, prothrombin time, activated partial thromboplastin time) was performed while obtaining intravenous access. If the bleeding was uncontrolled with anterior nasal packing and vital signs were stable, the patient went to the ear, nose and throat (ENT) department to see an otolaryngologist. In the ENT department, patients underwent diagnostic naso-endoscopy to locate the bleeding focus. After checking the anterior nasal cavity using a rigid zero-degree endoscope, the endoscope was passed into the nose along the nasal floor, checking the appearance of the septum, inferior turbinate and eustachian tube orifice. The endoscope was then reintroduced above the inferior turbinate to check the middle turbinate and middle meatus and was again passed posteriorly to check the nasopharynx. If the bleeding focus was found, the otolaryngologist treated epistaxis using bipolar diathermy and monitored for 30 minutes. If the bleeding stopped, the patient was discharged. However, if we could not find the bleeding focus despite bleeding, or if the bleeding continued despite cauterization, the patients were transferred to DOU for evaluation and treatment.

2.3 Data collection

Data from the ED department and ENT department were collected. Data included patient variables such as age, sex, residence area, route of visit to the ED, state of consciousness, vital signs, comorbidities, drug history (aspirin, warfarin) and Korean triage and acuity scale (KTAS) score. To minimize bias and ensure objectivity, this data was collected by members of the study team, including physicians from each department, who were not directly involved in the patient's care or treatment decisions. After the data were collected, researchers from each department discussed the appropriateness of the patient data collection and double-checked the treatment methods and outcomes. When visiting the ED, the severity of the patient was classified using the KTAS [12]. Patients were evaluated by classifying them into five levels: level 1, resuscitation; level 2, urgent; level 3, emergency; level 4, less urgent; and level 5, non-urgent. Bleeding at ED visit, revisit of ED or ENT department, laboratory data, bleeding site, electrocauterization, time from onset to ED visit, and stay time in the ED were investigated.

2.4 Statistical analysis

The characteristics of the study population are presented as means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Continuous variables between independent groups were compared using a two-sample *t*-test with unequal variances. In contrast, categorical variables were compared using the chi-square or Fisher's exact tests as appropriate. We constructed a series of multiple logistic regression models to determine the relevant risk factors for DOU care. Variables univariately predictive of DOU care at a 0.2 significance level were included. Multicollinearity was assessed, and none of the variables had a variance inflation factor >5. The results of the logistic regression analyses were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). The area under the receiver operating characteristic (AUROC) curve was analyzed to examine the prognostic performance of variables independently associated with DOU care. Dependent ROC curves were compared using the method described by DeLong et al. [13]. Data were analyzed using Stata/SE version 16.1 software for Windows (StataCorp, College Station, TX, USA). A two-sided *p*-value of 0.05 was considered significant.

3. Result

3.1 Study population

A total number of 1197 patients with non-traumatic epistaxis were included in the study. Among these patients, 75 with incomplete medical records or blood test results were excluded from the analysis. Finally, 1122 patients were analyzed, with a mean age of 56.4 ± 19.5 , 694 males and 429 females (Fig. 1). Among them, 1081 (96.3%) patients were discharged after simple management, and 41 (3.7%) patients needed DOU care. Detailed clinical characteristics are presented in Table 1.

3.2 Factors associated with DOU care: univariate factor analysis

When we compared the clinical characteristics between the discharge group and the DOU care group, the univariate analysis showed no significant differences in age, mental status, vital signs or past medical history. However, male patients or patients with warfarin medication tended to need DOU care. In addition, visit route, revisit after prior discharge and delayed visit significantly differed between groups (Table 1). The patients transferred from other medical facilities, revisiting after an initial ED discharge, and patients who delayed visits to the ED for more than 180 minutes resulted in a higher DOU care rate (68.3%, p = 0.008) (Table 1).

Vital signs and mental status had no difference in the uni-

	Non-traumatic epistaxis			
	Total $(n = 1122)$	Discharged group $(n = 1081)$	DOU care group $(n = 41)$	<i>p</i> -value
The number of patients	1122	1081	41	
Age, mean (SD), yr	56.4 ± 19.5	56.3 ± 19.6	59.1 ± 17.5	0.364
Sex, n (%)				
Male	693 (61.8)	661 (61.2)	32 (78.1)	0.029
Female	429 (38.2)	420 (38.8)	9 (21.9)	
Past medical history, n (%)				
Hypertension	417 (37.2)	396 (36.6)	21 (51.2)	0.058
Diabetes mellitus	162 (14.4)	154 (14.3)	8 (19.5)	0.346
Chronic renal disease	46 (4.1)	43 (4.0)	3 (7.3)	0.234
Cardiovascular disease	34 (3.0)	34 (3.1)	0 (0.0)	0.632
Cerebrovascular disease	12 (1.1)	11 (1.0)	1 (2.4)	0.362
Chronic liver disease	9 (0.8)	9 (0.8)	0 (0.0)	1.000
Drug history n (%)				
Aspirin	297 (26.5)	288 (26.6)	9 (22.0)	0.504
Warfarin	48 (4.3)	42 (3.9)	6 (14.7)	0.001
Visit route of ED, n (%)				
Direct visit	948 (84.5)	922 (85.3)	26 (63.4)	< 0.001
Inter-hospital transfer	174 (15.5)	159 (14.7)	15 (36.6)	
Revisit after ED discharge, n (%)	46 (4.1)	37 (3.4)	9 (22.0)	< 0.001
Time from onset to ED arrival, n (%)				
<180 min	584 (52.1)	571 (52.8)	13 (31.7)	0.008
$\geq 180 \min$	538 (47.9)	510 (47.2)	28 (68.3)	
Vital sign, mean (SD), mmHg				
Systolic blood pressure	136.1 (26.3)	136.3 (26.1)	132.4 (30.3)	0.359
Diastolic blood pressure	82.6 (15.7)	82.7 (15.6)	79.8 (17.0)	0.233
Mean arterial pressure	100.5 (18.5)	100.6 (18.4)	97.3 (20.9)	0.269
Heart rate	86.5 (13.4)	86.5 (13.3)	86.8 (17.0)	0.893
O_2 saturation (%)	97.8 (1.2)	97.8 (1.2)	97.8 (1.0)	0.986
Body temperature, °C	36.4 (0.3)	36.4 (0.3)	36.4 (0.4)	0.086
Mental state of scene, (%)				
Alert	1120 (99.8)	1080 (99.9)	40 (97.6)	0.072
Verbal	2 (0.2)	1 (0.1)	1 (2.4)	
KTAS, n (%)				
1–2	78 (7.0)	71 (6.6)	7 (17.1)	0.009
3–5	1044 (93.0)	1010 (93.4)	34 (82.9)	
Laboratory data				
WBC × $10^3/\mu$ L, mean (SD)	8.7 (27.8)	7.8 (2.6)	10.8 (9.4)	0.001
Hb, g/dL mean (SD)	13.4 (4.1)	13.5 (4.1)	11.1 (3.6)	< 0.001
PLT × $10^3/\mu$ L, mean (SD)	234.8 (121.7)	235.5 (122.9)	217.3 (80.9)	0.254
aPTT, mean (SD)	32.3 (11.0)	31.8 (8.2)	44.2 (37.8)	0.878
Active bleeding at ED arrival, n (%)	717 (63.9)	691 (63.9)	26 (63.4)	0.947
Ambiguous bleeding focus, n (%)	430 (38.3)	404 (37.3)	26 (63.4)	0.001
Electrocauterization, n (%)	487 (43.4)	479 (98.4)	8 (1.6)	0.019
Time of ED stay, mean (SD), min	315.0 (291.8)	314.5(286.7)	328.0 (409.2)	0.281

DOU, definite observational unit; ED, emergency department; KTAS, Korea Triage Acuity Scale; WBC, white blood cells; Hb, hemoglobin; PLT, platelet; aPTT, activated partial thromboplastin time; Continuous variables, mean (SD); Categorical variables, n (%). SD, standard deviation; O₂, oxygen.



FIGURE 1. Flowchart of patients with non-traumatic epistaxis visiting the emergency department (ED) (2016–2020).

variate analysis. Conversely, KTAS 3–5 patients needed DOU care. In the laboratory tests, the DOU care groups had lower Hb levels (13.5 g/dL vs. 11.1 g/dL, p < 0.001) (Table 1). When patients presented with ambiguous bleeding focus, it led to a significantly higher rate of DOU care than discharge (63.4% vs. 37.3%, p < 0.001). On the other hand, proper management of bleeding spots with electrocauterization led to less DOU care (44.3% vs. 19.5%, p = 0.019).

3.3 Factors in multiple analysis

Multiple logistic regression analyses were performed to identify the factors associated with the DOU care group (Table 2). The model included univariately predictive variables of DOU care at a 0.2 significance level. Male sex (OR = 3.606, p =0.003), Hypertension (OR = 2.362, p = 0.020), Inter-hospital transfer (OR = 2.358, p = 0.039), Verbal mental status (OR = 29.436, p = 0.035), Time from onset to ED arrival (\geq 180 min) (OR = 2.451 p = 0.030), and Revisit after prior ED discharge (OR = 8.813, p < 0.001), Hemoglobin level (OR = 0.724, p <0.001), were significant factors for DOU care.

3.4 Prognostic performance of multiple logistic regression model for predicting DOU care

Fig. 2 shows the results of the ROC curves of the multiple logistic regression models in predicting DOU care. The area under the curve for the multiple logistic regression model for predicting DOU care was 0.870 (95% CI: 0.819–0.922), indicating good prognostic performance.

4. Discussion

The current study's central conclusion is that most of the patients visiting ED with non-traumatic epistaxis do not necessitate DOU care and that there are several risk factors that could help identify patients who need DOU. These conclusions are based on the following results. First, only 41 patients among 1112 patients needed definitive observation care in ED. It composed 3.65% of the study population. The rest of the patients only required simple primary treatment. In addition, the patients who required definitive observation care have presented with the following characteristics. Male sex, hypertension (HTN), time of onset to ED arrival (\geq 180 min), Inter-hospital transfer visit route, AVPU mental status, lower Hb level and ED revisitation after prior discharge are associated with DOU care in patients with non-traumatic epistaxis.

4.1 Demographic risk factors

Male sex is a risk factor for DOU care in this study. Males required 3.606 (95% CI: 1.537–8.465) times more DOU care than females. This result was concomitant with the previous study. Hadar A *et al.* [14] and Li *et al.* [15] studies reported that men were male sex 2.07 (95% CI, 1.59–2.69) and 3.136 (95% CI, 1.50–6.55) times more likely to present with epistaxis than women. Daniell *et al.* [16] reported that nosebleeds are more common in males than females under the age of 49. Moreover, it has been suggested that the nasal mucosa in women is protected by estrogen, which may be the reason for the observed sex difference [17].

Another factor for DOU care was HTN. The ODD ratio for HTN was 2.358 (1.259–688.436, p = 0.020). Although there have not been any publications on the relationship between HTN and DOU care, many researchers have analyzed the relationship between HTN and epistaxis. A study by Byun *et al.* [18] showed a 1.47 (95% CI: 1.30–1.66) times higher risk of epistaxis in the hypertensive group. In addition, Lubianca *et al.* [19]'s and Liao Z *et al.* [20]'s studies also suggested that epistaxis may be associated with HTN. Our study focused on the relationship between HTN and DOU care. HTN has been considered a significant risk factor for DOU care in non-traumatic epistaxis patients [16, 17].

4.2 Prehospital and ED-related risk factors

Our results showed that patients who revisit ED after the initial discharge are more likely to require DOU care. The odd ratio of this patient group was 8.813 (95% CI: 3.317–23.411). A previous study also showed a similar result. Although the proportion of patients who revisit ED after being discharged from initial treatment was much lower at 4.1% compared to 37% in other studies [21]. It was higher in the DOU group at a rate of 22%. These patients were likely treated with temporary hemostasis, which could have led physicians to make a wrong decision to discharge.

In addition, inter-hospital transferred patients and the length of the time from onset to ED arrival (\geq 180 min) are also risk factors for DOU care. It is speculated that the probability of DOU care is high as the time is delayed because there are many cases where the treatment is not completed even after the primary treatment was done at another hospital. In addition, among laboratory values, Hb was a significant factor (95% CI: 0.630–0.832, p < 0.001). Our result was concomitant with previous results. Khan *et al.* [22] reported that the severity of the bleeding was associated with surgical intervention and hospitalization.

Level of consciousness is also a risk factor. Epistaxis

ΓΑΒLΕ 2. Multiple logistic regression analyses demonstrating factors associated with admission DOU care in patients
with non-traumatic epistaxis who visited the ED.

	DOU	DOU care	
Variables	Odds Ratio	95% CI	
Sex			
Female	Reference		
Male	3.606	1.537-8.465	
Medical history			
Hypertension	2.362	1.143-4.883	
Drug history			
Warfarin	2.708	0.833-8.806	
Visit route of ED, (%)			
Direct visit	Reference		
Inter-hospital transfer	2.358	1.044-5.328	
Time from onset to ED arrival, (\geq 180 min)	2.451	1.092-5.502	
Revisit after ED discharge	8.813	3.317-23.411	
Mental state of scene, (%)			
Alert	Reference		
Verbal	29.436	1.259-688.436	
KTAS, n (%)			
3–5	Reference		
1–2	2.533	0.871-7.372	
Laboratory data			
$\mathrm{WBC} \times 10^{3}/\mathrm{\mu L}$	1.002	0.995 - 1.009	
Hb, g/dL	0.724	0.630-0.832	
Identified bleeding focus, n (%)			
Identifies (bleeding focus positive)	Reference		
Ambiguous bleeding focus	1.961	0.876-4.390	
Successful management of electrocauterization (+)	0.424	0.164-1.095	

The multiple logistic regression model included all variables with a p-value of < 0.2 in the univariate analyses except variables that presumed to have interaction with other variables. CI, confidence interval; DOU, definite observational unit; ED, emergency department; KTAS, Korea Triage Acuity Scale; WBC, white blood cells; Hb, hemoglobin.



FIGURE 2. The area under the receiver operating characteristic curve in the multiple logistic regression model of nontraumatic epistaxis patient factors for predicting definite observational unit care (area under the curve: 0.870, 95% CI: 0.819–0.922). ROC, receiver operating characteristic.

patients with altered consciousness tend to receive more DOU care. Although we could not find any previous report which analyzed the correlation between the level of consciousness and DOU care in epistaxis, it is reasonable considering the loss of blood can cause a change in consciousness. In that situation, patients would need DOU care for their safety.

4.3 ENT-related risk factors

Two significant risk factors correlated to ENT care were identified in the univariate analysis: ambiguous bleeding focus and electrocauterization. Patients with ambiguous bleeding focus tend to need more DOU care. Most epistaxis occurs in the anterior site (85-90%), and approximately 10-15% occurs in the posterior site [14]. A previous studies reported that posterior bleeding is more related to hospitalization than anterior bleeding and requires twice as much packing [23, 24], making it more challenging to manage. However, in this study, instead of posterior nasal bleeding, ambiguous bleeding focus was associated with DOU care. In addition, patients with successful electrocautery tend to need less DOU care in univariate analysis. This result is consistent with Kallenbach et al. [25]'s study that reported the hospitalization period was increased by 2.810 (2.047-3.858) times in patients unable to undergo electrocautery. The location of the bleeding focus is vital in determining whether packing, cauterization or topical treatment is the most appropriate.

4.4 Limitation and strength

This study has several limitations. First, in previous studies and the literature, no particular scoring system to classify the severity of non-traumatic epistaxis in the ED were present. In addition, only the complete blood count (CBC), prothrombin time (PT), and activated partial thromboplastin time (aPTT) were mostly evaluated, and chemistry was not tested. Therefore, it was difficult to apply the severity scoring system used in patients with other bleedings such as traumatic brain injury [26]. As with general medical bleeding, it will be necessary to develop a comprehensive scoring system along with the patient's vital signs and epidemiological factors by adding a chemistry test. Second, the use of pre-hospital emergency medical services was also included in the route of ED direct visits. Due to the nature of our data, the contents of emergency treatment by pre-hospital EMS were not known, and some results may have been affected. Third, this was a retrospective study performed at a single center. Therefore, the findings are not immediately generalizable to the entire population. Further multicenter studies with larger sample sizes and prospective designs are required to substantiate our findings.

Despite these limitations, this study elucidated that epistaxis is one of the leading causes of ED visits. However, the majority of the non-traumatic epistaxis cases are not emergent. In addition to the already-known risk factors, the newly identified risk factors in this study will help to more accurately and efficiently triage non-traumatic epistaxis patients.

5. Conclusions

Sometimes epistaxis could be a life-threatening event. However, most patients who visit ED with non-traumatic epistaxis do not need emergency care. Patients with male sex, HTN, ED revisit after prior discharge, inter-hospital transfer, delayed ED arrival (>180 min), AVPU mental status and Hb level require more medical resources than those without these risk factors. Therefore, clinical guidelines based on these factors will enhance the cost-effective management of patients with non-traumatic epistaxis visiting ED.

AVAILABILITY OF DATA AND MATERIALS

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

DKK—draft manuscript preparation. CMS—draft manuscript preparation. JHP—critical review of the manuscript. SML—study conception and design. HCY—study conception and design. All authors reviewed the results and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the ethics committee of Chonnam National University Hospital (CNUH-2021-340; approval date, 2021.10.3). The need for informed consent has been waived owing to its retrospective nature.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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