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RESEARCH ARTICLE



## Risk factors for postoperative bleeding after endoscopic sinus surgery to treat chronic rhinosinusitis

Xuemei Qin\*, Qing Sun\*, Guohui Chen, Jian Liu, Tianle Gao, Guangping Bai and Zhiqiang Guo

Department of Otolaryngology, Qingpu Branch of Zhongshan Hospital, Fudan University, Shanghai, China

### ABSTRACT

**Background:** Although there has been progress in improving endoscopic sinus surgery (ESS), patients undergoing ESS are still at risk of postoperative bleeding. Little attention has been given to identifying specific risk factors for postoperative bleeding after ESS to treat chronic rhinosinusitis (CRS).

**Objectives:** The aim of this study was to identify the incidence and risk factors associated with postoperative bleeding in patients who underwent ESS to treat CRS.

**Materials and methods:** Six hundred and five patients with CRS who underwent ESS between 2017 and 2020 were included in this retrospective analysis. Univariate and multivariate analysis was performed to assess the association between the incidence of postoperative bleeding and the background characteristics.

**Results:** Out of 605 ESSs, 36 (6.0%) patients developed postoperative bleeding. Multiple logistic regression revealed that the use of antiplatelet and/or anticoagulant drugs, the presence of hypertension and the Lund-Mackay CT score were significantly correlated with the occurrence of postoperative bleeding.

**Conclusion:** Postoperative bleeding is a common complication following ESS. The risk factors for postoperative bleeding were as follows: the use of antiplatelet and/or anticoagulant drugs, hypertension and the Lund-Mackay CT score.

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### KEYWORDS

Postoperative complications; chronic rhinosinusitis; endoscopic sinus surgery; bleeding

## Introduction

Chronic rhinosinusitis (CRS) is characterized by sinonasal inflammation with a duration of at least 12 consecutive weeks, and it is associated with a high burden of otorhinolaryngologic disease [1]. Although endoscopic sinus surgery (ESS) is a well-established procedure for the treatment of CRS due to being a less invasive surgery than traditional open procedures, the adverse effect of postoperative bleeding is still a challenge [2]. Specific perioperative management of patients undergoing ESS should be planned with great care. In particular, surgeons performing ESS must consider the risk of postoperative bleeding. As such, close postoperative monitoring is necessary for patients undergoing ESS to quickly detect any signs of bleeding. The risk factors of postoperative bleeding related to ESS to treat CRS remain uncertain. The aim of our study was to investigate the incidence, the potential risk factors and the aetiology of postoperative bleeding in patients who underwent ESS to treat CRS.

## Materials and methods

### Data collection and study population

We retrospectively reviewed a total of 605 patients who had undergone ESS to treat CRS between February 2017 and

June 2020 in the Otolaryngology Division of Qingpu Branch of Zhongshan Hospital, Shanghai, China. There were 369 males and 236 females, with an age range of 12–86 years. All of the patients satisfied the diagnostic criteria for CRS according to the European Position Paper on Rhinosinusitis and Nasal Polyps [1]. The exclusion criteria were bleeding disorders or abnormal coagulation function, autoimmune disease requiring systemic immunosuppressive therapy; patients with organ dysfunction such as the liver or kidney were also excluded. This study was approved by the institutional review board of the Qingpu branch of the Zhongshan hospital. Written informed consent was obtained from the patients before enrolment.

Details of the patients' age, gender, smoking history, the use of anticoagulation and/or antiplatelet medications, Lund-Mackay score, surgical records, postoperative records, and other related factors were obtained. Postoperative bleeding was defined as bleeding requiring packing or surgery for control [3] and bleeding occurring within 30 days after surgery [4], following definitions used in the previous literature. The diagnostic criteria for hypertension were: (1) history of hypertension, taking oral antihypertensive drugs; (2) a clinical diagnosis of hypertension during hospitalization [5]. Antiplatelet and anticoagulant medications were routinely discontinued 7 days before the surgical operation

and switched to heparin unless contraindicated, then they resumed on the second day after surgery, depending on the patient's condition. The prothrombin time (PT) and international normalized ratio (INR) were examined to guide adjustment of the medication.

### Surgical procedure

ESS was carried out under general anaesthesia for 605 patients by a senior doctor with the assistance of a resident. The patient underwent ESS in which polypectomy and maxillary sinus anastomosis along with anterior and posterior ethmoidectomy were performed. The frontal, sphenoid sinus was cleared after the natural ostia were widely opened when a lesion was present. When the patients had a deviation of the nasal septum, septoplasty was performed in addition to ESS.

After the surgery, 1–2 sheets of polyvinyl alcohol (PVA) sponge patties (Merocel; Medtronic Inc., Mystic, CT) were gently placed into the nasal cavity and they were removed on the second postoperative day. Daily treatment included debridement and saline irrigation.

### Interventions

Postoperative bleeding needed to be examined, and it was usually treated with shrinkage of the blood vessels by placing a cotton pledget soaked in epinephrine (1:100,000) + lidocaine (2%) for 5 min. In addition, routine anterior nasal packing with Vaseline gauze or PVA was performed. Patients with posterior bleeds usually present with significant amounts of blood draining down the pharynx. However, if the source of bleeding is too brisk or is posterior, anterior nasal packing is unlikely to gain control of the bleed, and thus posterior nasal packing is required to stop the bleeding. A posterior nasal pack consisting of a Foley urinary catheter in the nasopharynx along with a nonabsorbable nasal pack placed anterior to the Foley catheter balloon was used in these cases. Two patients had to be returned to the operating room due to refractory postoperative bleeding.

### Statistical analysis

Statistical analysis was performed with SPSS software (SPSS for Windows 18.0, SPSS, Inc, Chicago, IL). The chi-squared test or Fisher's exact test was used to evaluate the prevalence of postoperative bleeding. Risk factors for postoperative bleeding after ESS were evaluated using univariate and multivariate logistic regression analysis. All  $p$ -values were two-sided and  $p < 0.05$  was considered statistically significant.

### Results

The incidence of postoperative bleeding according to the patients' characteristics is shown in Table 1. Postoperative bleeding occurred in 36/605 patients (6.0%). All episodes

were adequately treated and no major postoperative bleeding (a haemorrhage requiring a transfusion) occurred. No other serious complications such as optic nerve injury or cerebrospinal fluid leakage were recorded. In the univariate analysis, the use of antiplatelet and/or anticoagulant drugs, the presence of hypertension, and the Lund-Mackay CT score were correlated significantly with the occurrence of postoperative bleeding. Nevertheless, we did not find any other significant risk factors, including sex, age, previous sinonasal surgery, a history of diabetes, body mass index or the presence of polyposis.

The type and extension of surgery in patients who underwent ESS are shown in Table 2. According to our results, complete fronto-ethmoidectomy was the most common type of ESS (26.4%), and postoperative bleeding had the highest rate (11.1%) after sphenoidoethmoidectomy.

The first sign of postoperative bleeding was noted in 26 patients within 24 h after surgery, no patient between 25 and eight 48 h, 6 patients at day 2 when removing nasal packing, 2 patients between 3 and 7 days after surgery, and in 2 patients between 8 and 30 days after surgery (Table 3).

Multivariate logistic regression analysis indicated that the use of antiplatelet and/or anticoagulant drugs [odds ratio 2.848, 95% confidence interval (CI) 1.060–7.656,  $p < .05$ ], a history of hypertension (7.159, 95% CI 2.962–17.307,  $p < .001$ ) and the Lund-Mackay CT score (3.621, 95% CI 1.737–7.548,  $p < .001$ ) were independent risk factors for postoperative bleeding (Table 4).

### Discussion

ESS offers a high-definition field of view and allows for great accuracy during surgery. Although ESS has good safety and efficacy, the adverse effect of postoperative bleeding is still a challenging problem. Postoperative bleeding is the most common complication after ESS [3]. Here, we performed a retrospective study to investigate the associated risk factors of postoperative bleeding after ESS.

It has been reported that the incidence of postoperative bleeding in ESS ranges from 0.7% to 5.0% [3,6,7]. The incidence of postoperative bleeding following ESS in this study was 6.0%, and this finding is consistent with previous research. All postoperative bleeding after ESS in this study was managed successfully and safely. Although the majority of postoperative bleeding cases can be managed conservatively with routine packing, in severe cases, reoperation due to bleeding is required.

In the univariate analysis, we found that the use of antiplatelet and/or anticoagulant drugs, hypertension and the Lund-Mackay CT score significantly differed between the subjects with and without the occurrence of postoperative bleeding ( $p < .05$ ). Further multivariate logistic regression analysis may provide clarity on the exact mechanisms of these factors leading to bleeding.

With ageing of the population and the increasing number of comorbidities, there is an increasing frequency of the widespread use of long-term anticoagulation and/or antiplatelet therapy for therapeutic and prophylactic purposes in

**Table 1.** Risk factors associated with postoperative bleeding after endoscopic sinus surgery by univariate analysis.

Characteristic	Number of Patients with the characteristic (%)	Postoperative bleeding rate, N (%)	Univariate odds ratio (95% confidence interval)	p-Value
All patients	605	36 (6.0)	–	–
Gender			1.14 (0.58–2.19)	.860
Male	369 (61.0)	23 (6.2)		
Female	236 (39.0)	13 (5.5)		
Age (years)			1.91 (0.80–4.52)	.175
< 65	534 (88.3)	29 (5.4)		
≥65	71 (11.7)	7 (9.9)		
Previous sinonasal surgery			1.03 (0.31–3.50)	1.000
Present	49(8.1)	3(6.1)		
Absent	556 (91.9)	33(5.9)		
Use of anticoagulation and/or antiplatelet medications			3.47 (1.35–8.96)	.017
Do not use	569 (94.0)	30 (5.3)		
Use	36 (6.0)	6 (16.2)		
Diabetes			1.42 (0.53–3.80)	.409
No	542 (69.6)	31 (5.7)		
Yes	63 (30.4)	5 (7.9)		
Hypertension			6.92 (3.14–15.25)	.001
Yes	45(7.4)	11(30.6)		
No	560(92.6)	34(6.0)		
Body mass index			0.76 (0.31–1.88)	.673
<25	481 (79.5)	30 (6.2)		
≥25	124 (20.5)	6 (4.8)		
Smoking status			1.15 (0.56–2.36)	.710
Non-smoker	421 (69.6)	24 (5.7)		
Smoker	184 (30.4)	12 (6.5)		
Allergic rhinitis			1.20 (0.51–2.83)	.648
Yes	102(16.9)	7(6.9)		
No	503(83.1)	29(5.8)		
Lund–Mackay CT score			3.19 (1.59–6.41)	.002
<15	486 (80.3)	21 (4.3)		
≥15	119 (19.7)	15 (12.6)		
Polyposis			0.89 (0.45–1.77)	.863
No polyps	337 (55.7)	21 (6.2)		
Polyps	268 (44.3)	15 (5.6)		

**Table 2.** Type and extension of surgery in patients who underwent endoscopic sinus surgery.

Treatment procedure	Number of patients with surgery, N (%)	Postoperative bleeding rate, N (%)
Infundibulotomy	17 (2.8)	0 (0.0)
Partial ethmoidectomy	17 (2.8)	0 (0.0)
Total ethmoidectomy	160 (26.4)	7 (4.4)
Sphenoidotomy	34 (5.6)	2 (5.9)
Frontal sinusotomy	28 (4.6)	1 (3.6)
Sphenoethmoidectomy	117 (19.3)	13 (11.1)
Complete fronto-ethmoidectomy	169 (26.4)	7 (4.4)
Fronto-sphenoethmoidectomy	112 (11.9)	6 (8.3)
Total	605 (100.0)	36 (6.0)

**Table 3.** Compare of different time of postoperative bleeding after endoscopic sinus surgery.

Postoperative time point	Number of patients with postoperative bleeding	Constituent ratio (%)
0–24 h	26	72.2
25–48 h	0	0
At day 2 when removing nasal packing	6	16.7
3–7 days	2	5.6
8–30 days	2	5.6

**Table 4.** Risk factors for postoperative bleeding after endoscopic sinus surgery by multivariate analysis.

Variable	B	DF	Wald	p Value	Exp (B)	95% CI
Use of antiplatelet and/or anticoagulant drugs	1.047	1	4.305	.038*	2.848	1.060–7.656
Hypertension	1.968	1	19.105	.001*	7.159	2.962–17.307
Lund–Mackay CT score	1.287	1	11.794	.001*	3.621	1.737–7.548

DF: degrees of freedom; Exp (B): exponentiation of the B coefficient, odds ratio; CI: confidence interval. \* $p < .05$ .

cardiovascular or thromboembolic conditions [8]. We found that postoperative bleeding was associated with a history of taking anticoagulation and/or antiplatelet medications. This is consistent with previous studies [9]. Surgeons must assess

the risk/benefit balance between thrombosis and bleeding for each individual patient. Some high-risk individuals, such as those with mitral valve prostheses, cage ball or tilting disk aortic valves, and a stroke during the past 6 months,

should be assessed to ensure clotting adequacy by obtaining an international normalized ratio (INR) [10]. ESS is a relatively safe surgical procedure with a moderate risk of bleeding in patients receiving anticoagulant and/or antiplatelet therapy [11]. Therefore, stopping the medication prior to surgery and perioperative bridging with heparin in high-risk individuals undergoing ESS may enable a reduction in the risk of the surgical procedure.

Numerous studies have analysed the association between hypertension and the incidence of epistaxis [12,13]. In another study, the authors reported that hypertension is a major cardiovascular risk factor for postoperative bleeding after transsphenoidal surgery [14]. However, interactions between hypertension and epistaxis are controversial [15]. In the present study, we found that hypertension increased the risk of postoperative bleeding after ESS. Hypertension often leads to extensive spreading of the fragile blood vessel walls and can lead to disruption of the vascular integrity, resulting in postoperative bleeding. The pain and discomfort after surgery might also lead to an increased blood pressure. Therefore, intensive blood pressure management, particularly in the immediate postoperative period, is the key to reducing the number of postoperative bleeding events.

In addition, we found that postoperative bleeding was associated with the Lund-Mackay score. The Lund-Mackay score given on the basis of CT findings is widely used to assess the severity of CRS [16]. It was previously proven that the rate of postoperative bleeding is influenced by the extent of the ESS. We speculate that extensive surgery may contribute to enhanced exposure of the nasal cavity, mucosal injury/bleeding and the exposure of the sphenopalatine artery and its branches. Surgery for more extensive lesions, especially those close to the posterior part of the nasal cavity and sinus, might contribute to the occurrence of postoperative bleeding.

Previous studies have pointed to a correlation between previous sinus surgery and the complication rate [3,9]. However, this was not found in our study. With increasing experience and technical expertise, surgeons have become more skilled in both the identification of alternative anatomic landmarks and in completing viable procedures, even when conducting more complex revision ESS [17]. We believe that careful CT reading, accurate preoperative counselling and applying a delicate surgical technique are the keys to preventing postoperative bleeding, particularly in revision ESS.

In our study, postoperative bleeding occurred mostly within 24 h after surgery and at day 2 when removing nasal packing. There are objective parameters that could help us to identify “high-risk” patients and predict the risk of postoperative bleeding following ESS. Nevertheless, when such a risk exists, adequate preoperative preparation and close postoperative monitoring as well as patient education, is necessary to prevent postoperative bleeding.

This study has some limitations, including its non-randomized, retrospective nature and its single-centre design. This issue needs to be further explored with a larger sample size and a multicentre study in the future.

## Conclusion

In summary, postoperative bleeding is a common complication following ESS. Risk factors for postoperative bleeding after ESS to treat CRS were the use of antiplatelet and/or anticoagulant drugs, hypertension and the Lund-Mackay CT score. These results will provide reliable guidance for the prevention of postoperative bleeding after ESS.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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