

Bleeding risk associated with resection of the middle turbinate during functional endoscopic sinus surgery

Anya J. Miller, M.D.,¹ Michael Bobian, B.S.,² Ed Peterson, M.D.,³ and Robert Deeb, M.D.¹

ABSTRACT

Background: The decision to resect the middle turbinate (MT) during functional endoscopic sinus surgery is controversial. Although there have been a variety of studies that examined the functional outcome related to this maneuver, very few studies evaluated the potential for complications, in particular, epistaxis.

Objective: We sought to determine if resection of the MT during functional endoscopic sinus surgery leads to an increased risk for postoperative bleeding.

Methods: Patients who underwent functional endoscopic sinus surgery for chronic sinusitis or nasal polyposis between 2004 and 2014 at a single institution were analyzed for bleeding and other complications after resection of the MT.

Results: Between 2004 and 2014, 1185 sinus surgeries were performed by 18 surgeons. A propensity matched set of 228 patients who underwent turbinate resection, and 228 controls were selected based on predicted probabilities from a logistic regression that predicted turbinate resection and that was adjusted for age, sex, and procedure. There were 89 patients with bilateral turbinates removed and 139 with unilateral turbinates removed. There was no significant difference in major bleeding or other complication rates between the two groups. Patients who underwent resection of at least one MT were 3.95 times more likely to have minor bleeding compared with those who did not; this risk increased with the number of turbinates resected (trend $p = 0.008$). Patients on anticoagulation medications were at a significant risk of bleeding if their MT was removed ($p = 0.007$), whereas patients on aspirin or antiplatelet therapy were not at a significant risk.

Conclusion: There was no increased risk of major bleeding or other complication associated with resection of the MT. However, there was a significantly increased minor bleeding rate associated with MT resection, particularly if the patient was on anticoagulants.

(Am J Rhinol Allergy 30, 140–142, 2016; doi: 10.2500/ajra.2016.30.4273)

There are many treatment options for management of the middle turbinate (MT) in functional endoscopic sinus surgery (FESS). A wide variety of techniques exist, including placement of some kind of material lateral to the turbinate (in the ethmoid cavity) to aid in medialization, suturing of the turbinate to the septum, abrading the medial surface of the turbinate to promote adhesion to the septum, partial resection, and total resection.¹ Many practitioners agree that abnormalities, such as a concha bullosa or paradoxical MT, are a potential justification for partial or total removal. However, in cases of nasal polyposis or chronic sinusitis when the anatomy is relative normal, the opinion is more divided.

Most of the concern has centered around damage to the olfactory epithelium, cerebrospinal fluid leak, scarring of the frontal outflow tract, complications in revision cases, and airflow disturbances.^{1–4} There are many studies that evaluated functional outcomes related to various MT management techniques;^{5–7} however, very little research has been done to evaluate the potential complications associated with MT resection. Although there may be some clinical benefits to resection of the MT,⁸ weighing these benefits against postoperative bleeding has not been performed. Resection of the MT may lead to exposure of the sphenopalatine artery, which may increase the risk of postoperative bleeding. Bleeding from this artery has the potential for significant morbidity, with the possible need to return to the operating room for hemostatic control. Significant epistaxis can be difficult to control in a postsurgical nose and has the potential to be dangerous from an airway perspective. This study sought to determine if resection of the MT led to an increased rate of bleeding in patients who underwent FESS.

METHODS

This study was approved by the institutional review board of Henry Ford Hospital. A retrospective chart review was performed that included all patients who underwent FESS in the Henry Ford Health System between January 2004 and August 2014. Patients were identified by using the following Current Procedural Terminology codes (American Medical Association, Chicago, IL): 31235, 31270, 31237, 31240, 31254, 31255, 31256, 31263, 31265, 31267, 31268, 31275, 31276, 31275, 31277, 31287, and 31288. Only those patients who underwent surgery for sinusitis or nasal polyposis were included. Patients with sinonasal cancer or who underwent surgery for a pituitary adenoma were excluded. During that time period, a total of 1185 sinus surgeries were performed by 18 otolaryngologists.

The following variables were analyzed: (1) sinuses that were operated on (maxillary, sphenoid, ethmoid, and frontal), (2) whether or not resection of the MT(s) took place, and (3) any adjunctive procedures, *viz.* septoplasty that took place. In addition, patient charts were examined for medications that could increase the bleeding risk and were grouped into one of three classes: aspirin, “anticoagulation,” and antiplatelet therapy. Anticoagulation medications included warfarin, enoxaparin, and direct thrombin inhibitors, whereas antiplatelet therapy included clopidogrel, prasugrel, ticagrelor, and ticlopidine. Of note, aspirin, anticoagulation therapy, and antiplatelet therapy were routinely stopped 7 days before surgery and restarted 1–2 weeks after surgery.

During surgery, all the surgeons prophylactically cauterized the stump of the MT if it was resected. Placement of surgical packing was variable among surgeons. The patients were routinely started on salt water nose sprays the day after surgery and were seen 1–2 weeks after surgery for debridement. Routine postoperative instructions included keeping the head of the bed elevated, no straining, and open mouth sneezing.

Complications were defined as occurring within 30 days after surgery. Minor bleeding was defined as bleeding controlled without the need for surgical intervention but still significant enough to warrant the patient returning to the hospital (clinic or emergency department). Major bleeding was defined as bleeding that required surgical intervention for control. Other complications included orbital violation,

From the ¹Department of Otolaryngology, Henry Ford Health System, Detroit, Michigan, ²Wayne State University School of Medicine, Detroit, Michigan, and ³Department of Statistics, Henry Ford Health System, Detroit, Michigan
Presented at the Combined Otolaryngology Spring Meetings 2015, Boston, Massachusetts, April 22–26, 2015

The authors have no conflicts of interest to declare pertaining to this article
Address correspondence to Robert Deeb, M.D., 2799 West Grand Blvd., K-8 Otolaryngology, Detroit, MI 48202

E-mail address: Rdeeb1@hfhs.org

Copyright © 2016, OceanSide Publications, Inc., U.S.A.

orbital infection, cerebrospinal fluid leak, septal hematoma and/or abscess, meningitis, and myocardial infarction. Synechia formation was excluded in the analysis.

A logistic regression was used to predict one or two MTs removed separately. The covariates age, sex, sinuses operated on, and septoplasty performed were used. The predicted probability of turbinate removal was used to generate a control group that was propensity matched with the treatment group (patients with MT removed). These groups were then compared for differences between them by using the Student's *t*-test for continuous variables and χ^2 tests for nominal variables.

Postoperative bleeding rates were compared between no versus any turbinate removed by using logistic regression. An odds ratio of the complication along with its 95% confidence interval were generated. A more detailed logistic regression was used that compared one turbinate removed and two turbinates removed as separate variables. Finally, a $2 \times 3 \chi^2$ test was used to evaluate the number of turbinates

removed versus minor bleeding. An overall test and a Cochran-Armitage test for trend were examined.

RESULTS

Between January 2004 and August 2014, 2951 patients underwent FESS in the Henry Ford Health System for sinusitis or nasal polyposis. Of these, 251 patients had one or two MTs resected (162 with one and 89 with two MTs). Two hundred twenty-eight patients were able to be matched to a control group with matched covariates, which resulted in a total sample size of 456 patients. There were no differences between these two groups in terms of age, sex, sinuses operated on, and adjunctive procedures (Table 1).

Postoperative bleeding rates (minor and major) and complications were then analyzed between the two groups (Table 2). In patients with only minor bleeding, the source was not uniformly documented as being identified. There was no significant difference in the major bleeding rate between patients who did and patients who did not undergo MT resection. There also was no noted difference in the rate of other complications. There were significant differences in the minor bleeding rate with the patients who underwent at least one MT resection, being 3.95 times more likely to have minor bleeding. The minor bleed group was then further stratified according to how many turbinates were resected. In comparing patients who had no MT resection versus one MT resection, the likelihood of minor postoperative bleeding was significantly increased ($p = 0.043$). Similar significance was noted in comparing patients who underwent no MT resection with patients who underwent two MTs resection ($p = 0.018$). Overall, there was a 3.53-fold increased risk of minor bleeding for one turbinate removed and a 4.57-fold increase for two turbinates removed. This relationship was confirmed by a significant test for trend ($p = 0.008$). Patient medications were also analyzed against postoperative bleed rates (Table 3). Significance was found for increased minor bleeding rates in patients who had MTs resected and were on anticoagulation medication ($p = 0.007$) but not for other medications.

Table 1 Comparison of groups defined by turbinate status

Variable	No MT resected, % (<i>n</i> = 228)	MT(s) resected, % (<i>n</i> = 228)	<i>p</i> Value
Mean (SD) age, y	49.0 ± 14.7	50.0 ± 15.9	0.501
Women	48.7	48.7	0.999
Procedure			
Maxillary left	75.4	77.6	0.581
Maxillary right	76.8	79.4	0.497
Ethmoid left	71.5	73.7	0.600
Ethmoid right	74.6	77.2	0.511
Sphenoid left	38.2	35.5	0.560
Sphenoid right	35.5	34.2	0.768
Frontal left	25.4	30.3	0.251
Frontal right	27.6	29.8	0.605
Septoplasty	23.7	25.9	0.588

MT = middle turbinate; SD = standard deviation.

Table 2 Comparison of complications

Complication	No MT resected, % (no./total)	MT(s) resected, % (no./total)	<i>p</i> Value	OR (95% CI)	
Minor bleeding	1.75 (4/228)	6.58 (15/228)	0.016	3.95 (1.29–12.09)	
Major bleeding	0.88 (2/228)	0.44 (1/228)	0.570	0.50 (0.05–5.53)	
Other complication	0.88 (2/228)	0.44 (1/228)	0.616	0.50 (0.05–6.21)	
	No MT resected	1 turbinate	2 turbinates	<i>p</i> Value	OR (95% CI)
Minor bleeding	1.75 (4/228)	5.8 (8/139)*		0.043	3.53 (1.04–16.98)
Minor bleeding	1.75 (4/228)		7.9 (7/89)*	0.018	4.57 (1.30–16.12)

MT = middle turbinate; OR = odds ratio; CI = confidence interval.

*Cochran-Armitage test for trend = 0.008.

Bold represents significant value $p < 0.05$.

Table 3 Comparison of bleeding rates with medication usage

Medication	No bleeding, % (no./total)	Minor bleeding, % (no./total)	<i>p</i> Value	OR (95% CI)
MT(s) resected				
Aspirin	12.2 (26/213)	20.0 (3/15)	0.406	1.76 (0.46–6.68)
Anticoagulation	0.9 (2/213)	13.3 (2/15)	0.007	16.65 (2.15–129.22)
Antiplatelet therapy	0.5 (1/213)	6.7 (1/15)	0.058	15.59 (0.91–266.05)
No MT resected				
Aspirin	9.4 (21/224)	0 (0/4)	0.999	1.68 (0–10.12)
Anticoagulation	2.7 (6/224)	0 (0/4)	0.999	5.95 (0–40.89)
Antiplatelet therapy	0.5 (1/224)	0 (0/4)	0.999	43.78 (0–831.89)

OR = odds ratio; CI = confidence interval; MT = middle turbinate.

Bold represents significant value.

DISCUSSION

A variety of studies looked at outcomes after MT resection. There are a variety of concerns related to resection. These include the loss of an anatomic landmark, possible development of anosmia, stenosis of the frontal recess, development of atrophic rhinitis, loss of physiologic nasal function, and hemorrhage. There are some widely accepted indications for some degree of MT resection, which include management of concha bullosa and removal of disease that involves the turbinate. Despite the volume of literature both in support and against resection of the MT, there is little objective evidence to support one procedure over the other.⁹ The majority of these studies focuses on quality-of-life measures, which often use a validated questionnaire (such as the Sino-Nasal Outcome Test) to draw a given conclusion. In fact, Clement and White¹⁰ reviewed >500 articles that described turbinate surgery over a 35-year period, and not one randomized controlled study was identified. However, very few, if any studies, looked specifically at the risk of bleeding associated with MT resection.

A study by Shih *et al.*¹¹ evaluated 31 consecutive patients who had undergone unilateral MT resection, while leaving the contralateral side intact. There were no differences in the bleeding complications between the two groups. In 2008, Brescia *et al.*⁴ looked at 48 patients, 23 of whom had had their MT removed. They found that the bleeding rates between the two groups were similar and that none of the bleedings warranted surgical intervention. Havas and Lowinger¹² also found no difference in the bleeding rate with MT resection versus preservation in a cohort of >1000 patients. However, potential confounding factors of patient age, sex, and the nature of the surgery were not matched, thus comparison of complications could be skewed.

Biedlingmaier¹³ reported a retrospective review of 46 patients with partial MT resection in which a posterior stump was left as an anatomic landmark. The success rate, as defined by resolution or improvement of headache, was 93.5%; whereas only three patients bled after surgery. However, there was no control group analyzed in the study. A similar study by Biedlingmaier *et al.*,¹⁴ in 1996, reviewed 110 patients who underwent 198 MT resections, and only one patient required vessel ligation for bleeding.

The current study was unique in that postoperative bleeding was the primary metric being analyzed and that a control group was also analyzed. The majority of studies simply state a bleeding rate associated with the procedure of MT resection without comparing with a similar cohort whose MT was not removed. Our study found that there was no difference in the major bleeding rate between patients who did and patients who did not undergo MT resections. However, a significant difference was noted in the minor bleeding rate. This finding should be interpreted with caution because those patients who had minor bleeds were noted to be significantly more likely to be using anticoagulants.

Intuitively, this finding can be justified by considering the nature of post-sinus surgery bleeding. We defined minor bleeding as one that can be controlled with conservative measures, in the office or the emergency department setting. This implies that a mucosal "ooze" is likely the culprit. However, it should be noted that, in these instances, the exact anatomic source was not always documented and, therefore, may or may not have been due to resection of the MT. Furthermore, these types of "minor" bleeds are exacerbated by anticoagulant medications. Contrast that to major bleeding that requires a formal return to the operating room, with concomitant general anesthesia, to obtain control.

There are theories that a combination of physiologic and anatomic effects take place with resection of the MT, which renders a patient more susceptible to major postoperative bleeding. *Viz.*, the alteration in laminar airflow leads to increased postoperative crusting; also, resection of the MT leaves the sphenopalatine artery and its branches more exposed.^{2,15} Our results did not support this conclusion.

There are several pitfalls that we acknowledge. Given that there were a variety of surgeons included in the study, the resultant variability in surgical technique as well as postoperative care could lead to a variety of confounding factors. However, controlling for each type of postoperative packing and postoperative regimen would have rendered our cohort far too small for meaningful analysis. There also is the assumption that the bleeding is due to resection of the MT, which, in some cases, may not have been the source. It is possible that patients who did have their MT resected had more-extensive disease and, therefore, required a more-extensive procedure. However, we do believe that controlling the major confounding factors of age, sex, exact type of surgery performed, and nature of anticoagulant medications strengthened our results. This study also has all of the usual drawbacks of a retrospective review. However, given the generally good outcomes related to FESS, irrespective of MT resection, a randomized prospective study is unlikely.

CONCLUSION

Although there was no increased risk of major bleeding or other complications, there was a significantly increased minor bleeding rate associated with MT resection. Of those, patients on anticoagulation medications were at further increased risk of minor bleeding. Although a true causal relationship cannot be established, surgeons should be cognizant of these risks when deciding to remove the MT in a patient who is anticoagulated. Although the debate continues regarding clinical efficacy of MT resection, this study is one of few studies that showed an increased risk of the minor bleeding rate associated with the procedure.

REFERENCES

1. Vleming M, Middelweerd RJ, and de Vries N. Complications of endoscopic sinus surgery. *Arch Otolaryngol Head Neck Surg* 118: 617–623, 1992.
2. Kennedy DW. Middle turbinate resection: Evaluating the issues—Should we resect normal middle turbinates? *Arch Otolaryngol Head Neck Surg* 124:107, 1998.
3. Rice DH. Middle turbinate resection: Weighing the decision. *Arch Otolaryngol Head Neck Surg* 124:106, 1998.
4. Brescia G, Pavin A, Giacomelli L, et al. Partial middle turbinectomy during endoscopic sinus surgery for extended sinonasal polyposis: Short- and mid-term outcomes. *Acta Otolaryngol* 128:73–77, 2008.
5. Soler ZM, Hwang PH, Mace J, and Smith TL. Outcomes after middle turbinate resection: Revisiting a controversial topic. *Laryngoscope* 120:832–837, 2010.
6. Marchioni D, Alicandri-Ciuffelli M, Mattioli F, et al. Middle turbinate preservation versus middle turbinate resection in endoscopic surgical treatment of nasal polyposis. *Acta Otolaryngol* 128:1019–1026, 2008.
7. Byun JY, and Lee JY. Middle turbinate resection versus preservation in patients with chronic rhinosinusitis accompanying nasal polyposis: Baseline disease burden and surgical outcomes between the groups. *J Otolaryngol Head Neck Surg* 41:259–264, 2012.
8. Choby GW, Hobson CE, Lee S, and Wang EW. Clinical effects of middle turbinate resection after endoscopic sinus surgery: A systematic review. *Am J Rhinol Allergy* 28:502–507, 2014.
9. Nurse LA, and Duncavage JA. Surgery of the inferior and middle turbinates. *Otolaryngol Clin North Am* 42:295–309, ix, 2009.
10. Clement WA, and White PS. Trends in turbinate surgery literature: A 35-year review. *Clin Otolaryngol Allied Sci* 26:124–128, 2001.
11. Shih C, Chin G, and Rice DH. Middle turbinate resection: Impact on outcomes in endoscopic sinus surgery. *Ear Nose Throat J* 82:796–797, 2003.
12. Havas TE, and Lowinger DS. Comparison of functional endonasal sinus surgery with and without partial middle turbinate resection. *Ann Otol Rhinol Laryngol* 109:634–640, 2000.
13. Biedlingmaier JF. Endoscopic sinus surgery with middle turbinate resection: Results and complications. *Ear Nose Throat J* 72:351–355, 1993.
14. Biedlingmaier JF, Whelan P, Zoarski G, and Rothman M. Histopathology and CT analysis of partially resected middle turbinates. *Laryngoscope* 106:102–104, 1996.
15. Jones N. *Practical Rhinology*. Great Britain, London: Hodder Arnold; 2010. □

Copyright of American Journal of Rhinology & Allergy is the property of OceanSide Publications Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.