Received: 22 November 2022 | Revised: 3 January 2023 | Accepted: 22 January 2023

DOI: 10.1002/lio2.1023

ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Surgiflo® hemostatic matrix versus NasoPore® nasal packing following postassium titanyl phosphate laser surgery for hereditary hemorrhagic telangiectasia: A randomized controlled trial

Justin M. Pyne MD | Scott Murray MD | Brendan C. Kelly MD | Jin Soo Song MD | Brandon R. Rosvall MD | David W. J. Côté MD

University of Alberta, Division of Otolaryngology – Head and Neck Surgery, University of Alberta Hospital, Edmonton, Alberta, Canada

Correspondence
David W. J. Côté, MD, University of Alberta, Division of Otolaryngology-Head and Neck Surgery, University of Alberta Hospital, 8440 112 Street NW, Edmonton, Alberta, Canada T6G 2B7.
Email: cote@ualberta.ca

Funding information
Ethicon Canada

Abstract

Background: To help ensure adequate hemostasis immediately following potassium titanyl phosphate (KTP) laser treatment, many centres treating hereditary hemorrhagic telangiectasia (HHT) routinely use nasal packing post-operatively. The purpose of this study was to compare hemostatic thrombin matrix with standard packing for postoperative bleeding, patient pain, and comfort.

Methods: A prospective, randomized, double-blinded, non-inferiority study was conducted with participants at an HHT centre of excellence (COE) and randomized to the treatment group with reconstituted thrombin gelatin matrix (Surgiflo®) or control group with a biodegradable synthetic polyurethane foam (NasoPore®). Adult subjects with confirmed HHT and moderate to severe epistaxis (a minimum calculated epistaxis severity score [ESS] of 4.0) warranting KTP laser treatment were recruited. Data was collected 2 weeks post operatively by a blinded reviewer completing a visual outcomes evaluation and each patient completing a subjective symptoms questionnaire. Non-parametric statistical analysis was employed.

Results: Twenty-eight adult patients were randomized to the treatment and control arms with comparable preoperative epistaxis severity scores. Postoperative nasal bleeding was equivalent. Significantly less pain was found in the treatment arm ($p = .005$). While there were trends towards less obstruction and increased satisfaction in the treatment group as well as less crusting in the control group, these findings were not statistically significant. Allocation to the treatment group was associated with an approximately $75 higher cost.

Conclusions: When compared to NasoPore® for hemostasis, Surgiflo® hemostatic matrix performed equivalently while causing less discomfort in HHT patients following nasal KTP treatment.

Level of evidence: 1b.

KEYWORDS
epistaxis, hereditary hemorrhagic telangiectasia, nasal packing

1 | BACKGROUND

Hereditary hemorrhagic telangiectasia (HHT) is an autosomal dominant dysplastic condition affecting approximately 1:10,000.[1] It is associated with abnormal development of blood vessels which can occur in the sinonasal, respiratory or gastrointestinal mucosa, the skin, and/or as arteriovenous malformations (AVMs) elsewhere in the body.[2,3] As these individuals often form abnormal capillaries, a fragile region between vein and artery develops that is more prone to rupture. This can manifest as potentially life-threatening hemorrhage with major bleeding (such as epistaxis) occurring quite frequently. By the age of 40, almost 100% of HHT patients are significantly affected by epistaxis.[4]

The potassium titanyl phosphate (KTP) laser has been implemented in the treatment of numerous otolaryngologic diagnoses, including recurrent respiratory papillomatosis (RRP) and HHT.[5] It involves passing a 1064-nm Nd:YAG source through a KTP crystal in order to emit frequency-doubled light at a wavelength of 532 nm. This wavelength corresponds with the absorption peak of oxyhemoglobin, making its application to mucosal blood vessels relatively specific.[5] Moreover, it has been shown to improve quality of life outcomes for those suffering from HHT.[6]

Due to the high risk of bleeding for HHT patients in the immediate postoperative period following KTP laser treatment, many centres treating this population employ nasal packing routinely. Reported side effects from nasal packing included crusting, pain, obstructed nasal breathing, infections, eustachian tube dysfunction and atrophy of the nasal mucosa.[7–13] Mahoney et al are proponents for postoperative nasal packing (absorbable material soaked with Bactroban).[14] On the contrary, Bergler et al. feel that no packing is necessary following argon plasma coagulation.[15] Jung et al. conducted a randomized controlled trial in 2014 comparing NasoPore® with fibrin sealant for postoperative packing following functional endoscopic sinus surgery in 35 patients. They found that there were no differences in bleeding occurrence postoperatively, but the NasoPore® group reported significantly more subjective nasal obstruction[16] as well as more granulation and crusting in the early stages of the study.

Nasal packing practices following laser surgery for HHT vary between centres.[1,17] While some rhinologists may favor no nasal packing after these procedures, our experience in the early phase of the KTP laser treatment program demonstrated moderate to severe bleeding immediately following extubation which required intervention with intranasal hemostatic agents in all cases. As such, at our institution, which is an HHT centre of excellence (COE), the standard of care includes NasoPore® nasal packing as postoperative treatment following KTP treatment of intranasal HHT to maintain hemostasis in the early postoperative epistaxis. While better tolerated than non-resorbable packing, during the post-operative period, patients have complained of the associated nasal obstruction as well as the discomfort associated with debridement of persistent packing.

Surgiflo® Hemostatic Matrix is a Health Canada approved treatment option that is already in use hemostasis in several hospital settings,[18–20] including uncomplicated anterior epistaxis.[21] Surgiflo® reconstituted thrombin matrix is a combination of a flowable gelatin matrix and human thrombin that accelerates the formation of a platelet plug and aids in fibrin and clot formation. It allows precise placement and conforms to tissue providing a tamponade effect. Surgiflo® builds on a patient's natural coagulation cascade as the thrombin component of Surgiflo® acts as a catalyst, activating the patient's endogenous fibrinogen and accelerating fibrin clot formation. A recent study found that non-HHT patients preferred recombinant thrombin for controlling hemorrhage in comparison to traditional nasal packing based on comfort and pain measures.[21] Further, the consistency of the gelatin matrix compared to the polyurethane foam may be less uncomfortable to debride postoperatively.

There is a paucity of data evaluating the comfort and complication rate of Surgiflo® compared with NasoPore® when used for postoperative packing following laser treatment of HTT. This study aimed to compare a hemostatic human thrombin matrix with NasoPore® packing following KTP Laser surgery in the HHT patient population.

2 | METHODS

2.1 | Design and participant selection

A prospective, randomized, double-blinded non-inferiority study design was conducted at the University of Alberta Hospital in Edmonton, Alberta, Canada. Adult subjects were recruited who had been diagnosed with HHT, were referred to an otolaryngologist —head and neck surgeon for KTP laser treatment, and had a minimum calculated epistaxis severity score (ESS) of 4.0 (Figure 1). Subjects were excluded if they were on any anticoagulation medication, if they had a diagnoses of a bleeding dyscrasia(s), and if they had signs of active infection at the time of surgery. Only one side of the septum was operated on per procedure as per standard of care to minimize the risk of septal perforation. The control group consisted of those whose nose was packed with NasoPore®, and a standard 8 cm piece of material was utilized. The treatment group consisted of those who were packed with Surgiflo®. This is distributed in a standard size of 8 mL, and this is the dosing which was used in the study.

2.2 | Participant numbers

To obtain our cohort numbers, an ad hoc power calculation was performed assuming a non-inferiority study with a power of 0.80 and non-inferiority limit of 15% and alpha of 0.05 giving us a sample size of 28 (14 per group).

2.3 | Procedure

Participants were block randomized with allocation revealed only to a third-party individual who was not part of the patient treatment process to ensure double blinding. Once the laser portion of the

Question	Response	Multiplied by:		Coefficient	Result
1	Less than monthly Once per month Once per week Several per week Once per day Several per day	0 1 2 3 4 5	x	0.14 (0.70 Den)	
2	< 1 minute 1-5 minutes 6-15 minutes 16-30 minutes > 30 minutes	0 1 2 3 4	x	0.25 (1.00 Den)	
3	No Yes	0 1	x	0.25 (0.25 Den)	
4	No Yes	0 1	x	0.30 (0.30 Den)	
5	No Yes	0 1	x	0.20 (0.20 Den)	
6	No Yes	0 1	x	0.31 (0.31 Den)	
			TOTAL =	Denominator (Sum Den)	Raw Score

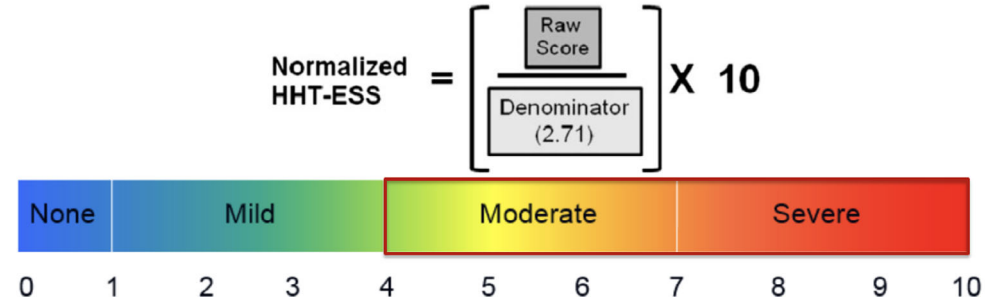

FIGURE 1 Epistaxis severity score table. The color spectrum at the bottom demonstrates highlights the range of scores required for a participant to be eligible to take place in the study.

procedure was completed, the primary surgeon exited the room, and the OHNS resident placed the nasal packing material according to the subjects allocation on the operated side, the procedure was concluded, and a standard postoperative course was resumed. All patients were discharged home from hospital on the day of surgery.

Participants were seen in follow-up approximately 14 days after their procedure. During this visit, the subject's nose was examined, debrided and data collection was conducted on objective measures questionnaire based on the domains of adhesions, bleeding, crusting, infection, and granulation (Appendix S1). This was adapted from previous literature[16,21–26] and modified to fit this study. The questionnaire was based on an ordinal scale from 0 (none/absent) to 3 (severe/gross). Each participant was then asked to fill out a subjective comfort measures questionnaire (Appendix S2) based on the domains of pain affecting behavior, pain following the procedure, pain during packing debridement, facial pressure, nasal obstruction, nasal bleeding, and general satisfaction. This was also adapted from previous publications on patient reported pain scales.[17,27] The behavioral rating aspect of the questionnaire was based on a categorical scale ranging from no pain (scaled as 0) and pain present, cannot be ignored, rest or bedrest required (scaled as 5). A box scale from 0 (being the least) and 10 (being the worst) was utilized for the domains of pain following treatment (0–14 days after surgery), pain during packing removal, facial pressure, nasal obstruction, and nasal bleeding. For the domain of general satisfaction, the 0–10 same box scale was used, however 10 represented the most satisfied whereas 0 represented the least satisfied. This was clarified with the participant prior to completion of the questionnaire. The subject did not view the questionnaire until after the debridement had taken place. Our primary endpoint of hemostasis following nasal packing was determined via the patient questionnaires.

2.4 | Statistical analysis

For statistical analysis, we performed an independent samples *t*-test to compare demographics and subjective and objective outcomes. This was done utilizing SPSS® statistics version 25 (IBM, Armonk, NY). A *p*-value of less than .05 was considered statistically significant.

3 | RESULTS

A total of 28 subjects were initially recruited in rolling fashion. One subject had to be removed from the pool due to active infection noted at the time of surgery thus an additional subject needed to be

recruited. This yielded a total of 14 subjects per cohort (Figure 2). The two groups were similar in terms of their demographics with no significant differences observed. Further, both groups had similar epistaxis severity scores. There was one notable bleeding episode reported which occurred after a subject in the Floseal® group blew his nose aggressively - despite preoperative counseling - and removed his packing himself before follow-up due to discomfort. This bleed was self-limiting and did not require further packing or medical intervention (Table 1).

Visuals depicting the preoperative intranasal mucosa as well as post-KTP treatment, post-Nasopore® packing and post-Surgiflo® placement are detailed in Figure 3A–D. In terms of the objective measures questionnaire, there were higher scores for adhesions, bleeding and crusting in the control group while the treatment group had greater scores for local infection and granulation. However, these relationships were not significant (Table 2). On review of the subjective comfort measures questionnaire, there were trends towards lower pain scores in the treatment group, although this was only perceived as significant in the behavioral rating scale (1.50 vs. 0.5, $p = .005$, CI 0.34–1.66). There were no differences observed between the two groups for facial pressure, nasal obstruction, and general overall satisfaction (Table 3).

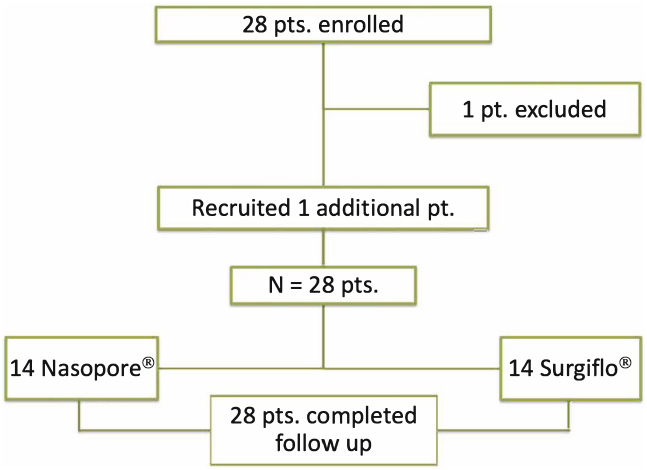

FIGURE 2 Participants who underwent laser treatment for intranasal hereditary hemorrhagic telangiectasia.

4 | DISCUSSION

While several treatment options exist for the management of HHT epistaxis, it remains a difficult and challenging diagnosis for the clinician and the patient. Initial management methods include nasal humidification, topical creams, and barrier creams.[28] On the more radical end of the treatment spectrum, the Young's procedure, involving complete nasal closure has been performed in select cases, with patients reporting good control of epistaxis, and no effect on quality of life in terms of sleep or nasal obstruction, however the patient does lose the ability to breathe through the nasal passage.[29] Given the frequency of epistaxis, HHT patients typically undergo frequent nasal packing which is understandably associated with pain and discomfort. KTP laser for treatment of intranasal telangiectasias associated with moderate to severe epistaxis has yielded significant benefit for patients as they can avoid nasal packing, transfusion, hospitalization and more aggressive interventions for longer periods of time. A retrospective review of 64 patients who underwent laser treatment for HHT was conducted by Richmon et al. in 2007 comparing the use of sprayed fibrin matrix with traditional nasal packing (majority with Merogel®, INSTAT®, Surgisis®, Epistat®, RapidRhino® or Vaseline® Gauze for the rest). The authors found that 20% of the postoperative nasal packing group required readmission to hospital compared with just 3% in the fibrin sealant group ($p = .04$), with an average cost of $5914 per stay.[30] Additionally, the fibrin sealant group reported improved a higher level of comfort postoperatively. There were no reported bleeding complications.

We aimed to investigate the use of a potentially more comfortable post-operative nasal packing material by implementing a recombinant thrombin gelatin matrix instead of the standard bioresorbable foam. Yu et al. examined the use of a fibrin sealant and its effect on hemostasis and wound healing in comparison to polyvinyl acetyl sponge packing following functional endoscopic sinus surgery in a randomized controlled trial. They found that granulation, crusting, and the amount of bleeding and pain during debridement were lower for the fibrin group compared with the acetyl sponge group, and that the former had a higher degree of general satisfaction.[25] While our hypothesis was correct in that similar rates of postoperative bleeding were observed between the two groups, participants indicated a similar degree of comfort based on their questionnaire scores. Given that the treatment group had a significantly lower level of pain based on behavioral scores, and there were trends

TABLE 1 Participant demographics.

Variable	Total	NasoPore®	Surgiflo®	p	CI
Age, years (mean)	54.54	56.57	52.5	.49	−7.96 to 16.10
Sex (M/F)	15/13	7/7	8/6	.7	−0.45 to 0.30
ESS (mean)	5.84	5.97	5.71	.67	−0.98 to 1.49
Days to follow-up (mean)	16.64	18.71	14.57	.15	−1.57 to 9.85
Major complication (mean)	0.04	0	0.07	.31	−0.22 to 0.076
Minor complication (mean)	0	0	0	1	-

Abbreviation: CI, confidence interval for difference in means between groups; F, female; M, male.

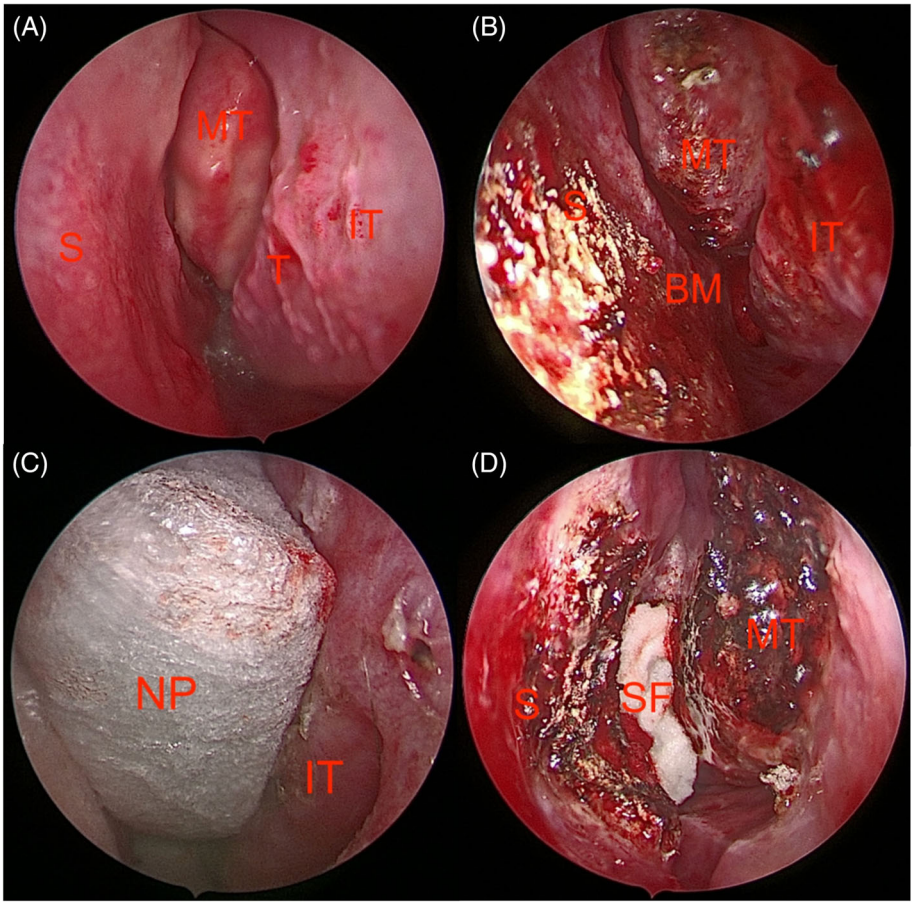

FIGURE 3 (A) Endoscopic intranasal view of left nasal cavity. IT, inferior turbinate; MT, middle turbinate; S, septum; T, telangiectasia. (B) Endoscopic intranasal view of left nasal cavity following KTP laser treatment. BM, bleeding mucosa; IT, inferior turbinate; MT, middle turbinate; S, septum. (C) Endoscopic intranasal view of left nasal cavity post-KTP laser treatment with Nasopore® nasal packing. IT, inferior turbinate; NP, NasoPore®. (D) Endoscopic intranasal view of left nasal cavity post-KTP laser treatment with Surgiflo® placement. MT, middle turbinate; S, septum; SF, Surgiflo®.

TABLE 2 Visual questionnaire results comparing mean scores between groups.

Variable (mean)	Total	NasoPore®	Surgiflo®	*p*	CI
Adhesions	1.61	1.79	1.42	.23	−0.16 to 0.88
Bleeding	1.04	1.21	0.86	.27	−0.17 to 0.89
Crusting	1.57	1.64	1.5	.77	−0.58 to 0.87
Infection	0.14	0.07	0.21	.5	−0.61 to 0.32
Granulation	1.29	1.14	1.43	.18	−0.75 to 0.18

Abbreviation: CI, confidence interval for difference in means between groups.

TABLE 3 Comfort questionnaire results comparing mean scores between groups.

Variable (mean)	Total	NasoPore®	Surgiflo®	*p*	CI
Pain following treatment	1.43	1.71	1.14	.48	−1.06 to 2.20
Pain during debridement	1.79	1.93	1.64	.72	−1.31 to 1.88
Pain (BRS)	1	1.5	0.5	.005	0.34–1.66
Facial pressure	2.5	2.5	2.5	1.00	−2.71 to 2.71
Nasal obstruction	5.5	6.14	4.86	.34	−1.42 to 3.99
Nasal bleeding	2.29	2.57	2	.53	−1.27 to 2.41
General satisfaction	7.04	6.79	7.29	.64	−2.64 to 1.64

Abbreviation: CI, confidence interval for difference in means between groups.

towards lower pain following treatment and debridement, it is reasonable to suggest that these findings indicate an improved degree of comfort as well.

The debate surrounding debridement of the nasal cavity at some point during the postoperative period following intranasal surgery appears to be ongoing.[31–33] While most studies are cases series

and/or retrospective reviews, a randomized controlled trial by Bugten et al. suggests that debridement of the nasal cavity following endoscopic sinus surgery is crucial to reduce the amount of crusting and fibrin clot, and subsequent adhesions that could otherwise arise.[34] Further, a systematic review examining nasal debridement following functional endoscopic sinus surgery highlighted that most studies showed that there was no observed difference between debridement and no debridement, but that the investigations by Bugten were the only literature that showed an improvement in visual analogue scores with the former.[35] However, Bugten did not place absorbable packing into the nasal cavity, rather allowed the mucosa to heal and achieve hemostasis independently.[34]

In terms of limitations, we recognize that the Surgiflo® treatment is approximately $75 canadian dollars more than then NasoPore® treatment. While we did not conduct a formal cost analysis, one may argue that the added decreased pain benefit of the former outweighs the down side of added cost. During our review, we did not identify any studies within the literature describing debridement following epistaxis treatment. However, the role for debridement in the setting of HHT patients following nasal KTP laser surgery is to improve nasal airflow as well as prevent the formation of intranasal synechiae, which has been known to occur after placement of nasal packing materials following nasal surgery.[36]

Patients have reported significant pain and bleeding during the debridement procedure, which has been observed in our institution as well. While methods to decrease this pain burden such as topical anesthetic and good nasal hygiene following surgery until follow-up may be beneficial, our hope was that a more fluid-like material would help to alleviate this further. Various factors such as patient pain tolerance and amount of topical anesthetic may have contributed to this, however we would have expected this to affect all pain measures equally.

5 | CONCLUSION

In conclusion, this is the first reported study investigating recombinant thrombin matrix for post-operative nasal packing following KTP laser treatment of intranasal HHT. When compared to NasoPore® for hemostasis, Surgiflo® hemostatic matrix performed equivalently while causing less discomfort in HHT patients following nasal KTP treatment. Future study may include a longer follow-up period to evaluate any late presenting sequalae within each group.

FUNDING INFORMATION

This research was supported by a grant obtained from Ethicon® (Johnson & Johnson Canada) in the form of material supply for the study.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

CONSENT FOR PUBLICATION

Consent for publication has been obtained from individual subjects where necessary.

ORCID

Justin M. Pyne https://orcid.org/0000-0003-1389-2151

REFERENCES

1. Wirsching KEC, Kühnel TS. Update on clinical strategies in hereditary hemorrhagic telangiectasia from an ENT point of view. *Clin Exp Otorhinolaryngol*. 2017 Jun;10(2):153-157. doi:10.21053/ceo.2016.00318
2. *Facts about hereditary hemorrhagic telangiectasia (HHT) | CDC*. Centers for Disease Control and Prevention; 2019 www.cdc.gov/ncbddd/hht/index.html
3. Shovlin C. (2022) Clinical manifestations and diagnosis of hereditary hemorrhagic telangiectasia (Osler-Weber-Rendu syndrome). *UpToDate*. Retrieved September 5, 2022, from: www.uptodate.com/contents/clinical-manifestations-and-diagnosis-of-hereditary-hemorrhagic-telangiectasia-osler-weber-rendu-syndrome.
4. Faughnan ME, Palda VA, Garcia-Tsao G, et al. International guidelines for the diagnosis and management of hereditary haemorrhagic telangiectasia. *J Med Genet*. 2011;48(2):73-87. doi:10.1136/jmg.2009.069013
5. Dodhia S, Baxter PC, Ye F, Pitman MJ. Investigation of the presence of HPV on KTP laser fibers following KTP laser treatment of papilloma. *Laryngoscope*. 2018;128(4):926-928. doi:10.1002/lary.27018
6. Kuan EC, Peng KA, Thompson CF, Suh JD, Wang MB. Sinonasal quality of life outcomes following laser treatment of epistaxis related to hereditary hemorrhagic telangiectasia. *Lasers Med Sci*. 2017;32(3):527-531. doi:10.1007/s10103-017-2144-7
7. Tierney PA, Samuel D, Patel KS, Thomas DM. Audit of patient acceptance of nasal surgery as a day case procedure. *Br J Clin Pract*. 1996;50(7):357-359.
8. Weber R, Hochapfel F, Draf W. Packing and stents in endonasal surgery. *Rhinology*. 2000;38(2):49-62.
9. Morgan NJ, Soo G, Frain I, Nunez DA. Do ventilated packs reduce post-operative eustachian tube dysfunction? *Clin Otolaryngol Allied Sci*. 1995;20(5):411-412. doi:10.1111/j.1365-2273.1995.tb00072.x
10. Kalogjera L, Pegan B, Petric V. Adaptation to oral breathing after anterior nasal packing. *Acta Otolaryngol*. 1995;115(2):304-306. doi:10.3109/00016489509139315
11. Orlandi RR, Lanza DC. Is nasal packing necessary following endoscopic sinus surgery? *Laryngoscope*. 2004;114(9):1541-1544. doi:10.1097/00005537-200409000-00007
12. Repanos C, McDonald SE, Sadr AH. A survey of postoperative nasal packing among UK ENT surgeons. *Eur Arch Oto-Rhino-Laryngol*. 2009;266(10):1575-1577. doi:10.1007/s00405-009-0978-8
13. Chheda N, Katz AE, Gynizio L, Singer AJ. The pain of nasal tampon removal after nasal surgery: a randomized control trial. *Otolaryngol-Head Neck Surg*. 2009;140(2):215-217. doi:10.1016/j.otohns.2008.09.012
14. Mahoney EJ, Shapshay SM. Nd-YAG laser photocoagulation for epistaxis associated with hereditary hemorrhagic telangiectasia. *Laryngoscope*. 2005;115(2):373-375. doi:10.1097/01.mlg.0000154749.09303.e0
15. Bergler W, Riedel F, Baker-Schreyer A, Juncker C, Hörmann K. Argon plasma coagulation for the treatment of hereditary hemorrhagic telangiectasia. *Laryngoscope*. 1999;109(1):15-20. doi:10.1097/00005537-199901000-00004
16. J Jung MS, Choi CH, Yu MS. Comparison of the effect of aerosolized fibrin sealant and biodegradable synthetic polyurethane foam on hemostasis and wound healing after endoscopic sinus surgery: a

prospective randomized study. *Int Forum Allergy Rhinol*. 2017;7(11):1089-1094. doi:10.1002/alr.22011
17. Kluger PB, Shapshay SM, Hybels RL, Bohigian RK. Neodymium-YAG laser intranasal photocoagulation in hereditary hemorrhagic telangiectasia: an update report. *Laryngoscope*. 1987;97(12):1397-1401. doi:10.1288/00005537-198712000-00004
18. Ma L, Dai L, Yang Y, Liu H. Comparison the efficacy of hemorrhage control of Surgiflo haemostatic matrix and absorbable gelatin sponge in posterior lumbar surgery: a randomized controlled study. *Medicine*. 2018;97(49):e13511. doi:10.1097/MD.0000000000013511
19. Woodworth BA, Chandra RK, LeBenger JD, Ilie B, Schlosser RJ. A gelatin-thrombin matrix for hemostasis after endoscopic sinus surgery. *Am J Otolaryngol*. 2009;30(1):49-53. doi:10.1016/j.amjoto.2007.11.008
20. Dhanota H, Pinkas D, Josserand D, Wiater BP, Koueiter DM, Wiater JM. Use of a topical thrombin-based hemostatic agent in shoulder arthroplasty. *Am J Orthop (Belle Mead NJ)*. 2015;44(8):E262-E267.
21. Murray S, Mendez A, Hopkins A, El-Hakim H, Jeffery CC, Côté D. Management of persistent epistaxis using floseal hemostatic matrix vs. traditional nasal packing: a prospective randomized control trial. *J Otolaryngol - Head Neck Surg*. 2018;47(1):3. doi:10.1186/s40463-017-0248-5
22. Bugten V, Nordgård S, Skogvoll E, Steinsvåg S. Effects of nonabsorbable packing in middle meatus after sinus surgery. *Laryngoscope*. 2006;116(1):83-88. doi:10.1097/01.mlg.0000184581.67185.6 e
23. Kim YS, Kim YH, Kim NH, Kim SH, Kim KR, Kim KS. A prospective, randomized, single-blinded controlled trial on biodegradable synthetic polyurethane foam as a packing material after septoplasty. *Am J Rhinol Allergy*. 2011;25(2):e77-e79. doi:10.2500/ajra.2011.25.3600
24. Valentine R, Athanasiadis T, Moratti S, Hanton L, Robinson S, Wormald PJ. The efficacy of a novel chitosan gel on hemostasis and wound healing after endoscopic sinus surgery. *Am J Rhinol Allergy*. 2010;24(1):70-75. doi:10.2500/ajra.2010.24.3422
25. Yu MS, Kang SH, Kim BH, Lim DJ. Effect of aerosolized fibrin sealant on hemostasis and wound healing after endoscopic sinus surgery: a prospective randomized study. *Am J Rhinol Allergy*. 2014;28(4):335-340. doi:10.2500/ajra.2014.28.4047
26. Shoman N, Gheriani H, Flamer D, Javer A. Prospective, double-blind, randomized trial evaluating patient satisfaction, bleeding, and wound healing using biodegradable synthetic polyurethane foam (NasoPore) as a middle meatal spacer in functional endoscopic sinus surgery. *J Otolaryngol - Head Neck Surg*. 2009;38(1):112-118.
27. Gloth FM 3rd, Scheve AA, Stober CV, Chow S, Prosser J. The functional pain scale: reliability, validity, and responsiveness in an elderly population. *J Am Med Dir Assoc*. 2001;2(3):110-114.
28. Chin CJ, Rotenberg BW, Witterick IJ. Epistaxis in hereditary hemorrhagic telangiectasia: an evidence based review of surgical management. *J Otolaryngol - Head Neck Surg*. 2016;45:3. doi:10.1186/s40463-016-0116-8
29. Thomson RS, Molin NL, Whitehead KJ, et al. The effects of nasal closure on quality of life in patients with hereditary hemorrhagic telangiectasia. *Laryngoscope Investig Otolaryngol*. 2018;3:178-181. doi:10.1002/lio2.157
30. Richmon JD, Tian Y, Husseman J, Davidson TM. Use of a sprayed fibrin hemostatic sealant after laser therapy for hereditary hemorrhagic telangiectasia epistaxis. *Am J Rhinol*. 2007;21(2):187-191. doi:10.2500/ajr.2007.21.2969
31. Thaler ER. Postoperative care after endoscopic sinus surgery. *Arch Otolaryngol-Head Neck Surg*. 2002;128(10):1204-1206. doi:10.1001/archotol.128.10.1204
32. Senior BA, Kennedy DW, Tanabodee J, Kroger H, Hassab M, Lanza D. Long-term results of functional endoscopic sinus surgery. *Laryngoscope*. 1998;108(2):151-157. doi:10.1097/00005537-199802000-00001
33. Bernstein JM, Lebowitz RA, Jacobs JB. Initial report on postoperative healing after endoscopic sinus surgery with the microdebrider. *Otolaryngol-Head Neck Surg*. 1998;118(6):800-803. doi:10.1016/S0194-5998(98)70272-4
34. Bugten V, Nordgård S, Steinsvåg S. The effects of debridement after endoscopic sinus surgery. *Laryngoscope*. 2006;116(11):2037-2043. doi:10.1097/01.mlg.0000241362.06072.83
35. Green R, Banigo A, Hathorn I. Postoperative nasal debridement following functional endoscopic sinus surgery, a systematic review of the literature. *Clin Otolaryngol*. 2015;40(1):2-8. doi:10.1111/coa.12330
36. Wang YP, Wang MC, Chen YC, Leu YS, Lin HC, Lee KS. The effects of Vaseline Gauze strip, Merocel, and NasoPore on the formation of synechiae and excessive granulation tissue in the middle meatus and the incidence of major postoperative bleeding after endoscopic sinus surgery. *J Chin Med Assoc*. 2011;74(1):16-21. doi:10.1016/j.jcma.2010.09.001

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Pyne JM, Murray S, Kelly BC, Song JS, Rosvall BR, Côté DWJ. Surgiflo® hemostatic matrix versus NasoPore® nasal packing following postassium titanyl phosphate laser surgery for hereditary hemorrhagic telangiectasia: A randomized controlled trial. *Laryngoscope Investigative Otolaryngology*. 2023;8(2):328-334. doi:10.1002/lio2.1023