Received: 9 February 2022 | Revised: 27 May 2022 | Accepted: 14 June 2022

DOI: 10.1002/lio2.841

ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Effect of desmopressin on bleeding during endoscopic sinus surgery: A randomized clinical trial

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Funding information
Guilan University of Medical Sciences, Grant/Award Number: 2263

Abstract

Background: This study aimed to evaluate the effect of local nasal desmopressin premedication on blood loss and the quality of surgical field in Functional Endoscopic Sinus Surgery (FESS).

Material and methods: In a randomized clinical trial, patients referred for FESS to treat their bilateral chronic rhinosinusitis were recruited. The participants were adults (≥18 years). They were randomly assigned (1:1:1) to receive low-dose (20 μg) or high-dose (40 μg) intranasal desmopressin (DDAVP) or placebo 60 min before the induction of general anesthesia. Standard FESS was performed by the same surgeon. The primary outcomes were volume of intraoperative bleeding and the quality of surgical field. Clean surgical field was defined as a score ≤2 on the Boezaart grading system.

Results: A total of 120 patients were included on an intention-to-treat basis (mean age: 41.0 years; 40 women, 80 men). There were no significant differences in primary outcomes between low-dose DDAVP and placebo. As for the volume of blood loss, however, there was a significant difference between high-dose DDAVP and placebo (mean difference: 29.6 ml; adjusted Cohen's d: −1.02; $p < .001$). Also, in the high-dose DDAVP, the probability of having a good surgical field over time was about two times higher than in the placebo group (RRs for first and second surgical sides: 1.89 and 2.18). The number needed to treat for the two time points was 1.6 and 1.3, respectively.

Conclusion: The present study showed that the use of desmopressin at a dose of 40 μg 1 h before surgery can reduce bleeding and improve the quality of the surgical field. Further studies are recommended to be able to generalize these findings to other ENT surgeries.

Level of evidence: 1b.

KEYWORDS

desmopressin, minimally invasive surgical procedures, sinusitis, surgical blood loss, transnasal endoscopic microsurgery

1 | INTRODUCTION

Rhinosinusitis is an inflammatory process in the nose and paranasal sinuses that can be characterized by certain clinical manifestations, endoscopic findings, and changes in imaging. Chronic rhinosinusitis indicates the persistence of the symptom for more than 12 weeks. When a patient does not respond well to the maximum drug treatment, surgery is prescribed.[1] Functional endoscopic sinus surgery (FESS) is a common procedure for the surgical management of chronic rhinosinusitis. Endoscopic sinus surgery directly targets the patient's sinuses and obstruction sites. Although endoscopic sinus surgery is a safe procedure, it can be associated with minor and major complications.[2]

Control of bleeding in the surgical field is a critical factor in FESS outcomes. Even a minimal bleeding may compromise the visualization of the anatomic landmark, prolong the operation time, increase the incidence of surgical complications, and compromise the outcomes.[3–5] To date, many efforts have been made to improve the surgical field during FESS. These include reverse Trendelenburg positioning, topical vasoconstrictors, local infiltration of lidocaine with 1:80000 or 1:100000 adrenaline, preoperative antibiotics and steroids, topical vasoconstrictors, local injection of epinephrine, a controlled hypotensive anesthesia, total intravenous anesthesia, premedication with beta blockers or clonidine, use of suction bipolar cautery, and powered instruments such as the microdebrider.[1–6] Although they are all used routinely, none of them can permanently provide an ideal surgical field for the surgeon, and bleeding in FESS remains a challenge for surgeons and anesthesiologists alike.

Desmopressin (1-deamino-8-d-arginine vasopressin, DDAVP) was originally introduced for the treatment of central diabetes insipidus[7] and later in patients with spontaneous bleeding or trauma-related hemorrhage or for bleeding prophylaxis (e.g., surgical bleeding) in selected patients. The drug can be used in oral form, as nasal spray or as an intravenous injection. Desmopressin affects hemostasis through increasing plasma concentrations of coagulation factor VIII, von Willebrand factor (vWF) and tissue plasminogen activator, improving platelet adhesiveness and exerting a probable effect on vascular stability. Desmopressin selectively stimulates the vasopressin 2 receptor, reducing transient hypertension and antidiuretic effects.[8] This drug can be administered in an oral form, as intranasal spray and as an intravenous injection. Surgeons have recently paid further attention to the hemostatic effects of desmopressin. Several randomized clinical trials (RCTs) have been conducted on patients undergoing various types of surgeries. Two clinical studies have evaluated the effects of nasal spray on FESS.[9,10] An initial RCT demonstrated that premedication with low dose (20 μg) DDAVP nasal spray significantly reduces bleeding and improves the quality of the surgical field.[9] In the second RCT, Safaeian et al. showed similar findings after premedication with DDAVP nasal spray (20 μg) during endoscopic sinus surgery.[10] Nonetheless, there are several concerns regarding the methodology of these studies.[11] Two other RCTs also evaluated the effects of intravenous desmopressin on bleeding and quality of the surgical field.[12,13] The effect of intranasal (local) desmopressin administration on intraoperative blood loss in endoscopic sinus surgery is therefore limited. The primary outcomes of the present study were to determine the effect of the administration of different doses (minimum and maximum) of intranasal desmopressin on intraoperative blood loss and the quality of surgical field in patients undergoing endoscopic sinus surgery.

2 | MATERIALS AND METHODS

A double blind RCT was conducted among patients undergoing endoscopic nasal surgery at Amiralmomenin Hospital of Guilan University of Medical Sciences (GUMS) in Rasht, Iran. The study was carried out from February 2020 to July 2021. The research was approved by the Ethics Committee of GUMS (IR.GUMS.REC.1399.504) and complies with the rules delineated in the Helsinki Declaration. Also, the trial was registered at the Iranian Registry of Clinical Trials (IRCT 20200708048051N2). Informed consent was obtained from each subject prior to participation. Candidates of primary sinus surgery who were 18–60 years old and had a diagnosis of chronic bilateral rhinosinusitis with no response to maximal pharmacotherapy were included in the study. Subjects were excluded if they had abnormal coagulation tests, any evidence of cardiovascular, brain disease, and sinonasal tumors, pregnancy, or use of anticoagulants, herbal medicines, vitamin E, diuretics, and corticosteroids (within the last 2 weeks). The extent of chronic rhinosinusitis was graded according to the Lund-Mackay scale for all the patients (based on preoperative computed tomography studies).[14] The same surgical technique was used for all the cases by the same surgeon.

The participants were randomized 1:1:1 to receive either (A) Low-dose desmopressin (LD-DDAVP, 20 μg), including a single dose of Desmex nasal spray, 10 μ/dose, made by Sina Darou Laboratories Company (Tehran, Iran) and a single dose of NaCl 0.65% nasal spray, made by Raha Pharmaceutical Company (Isfahan, Iran) in each nostril; (B) high-dose desmopressin (HD-DDAVP, 40 μg), including a double dose of Desmex nasal spray in each nostril; (C) placebo, including a double dose of NaCl 0.65% nasal spray in each nostril. Random assignment was based on a random table generated using PASS software, version 11 (NCSS). Block randomization with a block size of six and equal allocation was used to prevent imbalances in treatment assignments. Randomization and blinding were carried out by an independent pharmacist, and all the other members of the trial were blinded to the group allocation. The details of the series were unknown to the investigators, and the group assignments were kept in sealed envelopes, each bearing only the case number on the outside. After recruitment, the patients were given a case number, and 1 h before admitting the patient into the operating room, the numbered envelope was opened and the card inside determined the group into which the patient would be placed. To maintain blinding, nasal sprays (Desmex or NaCl 0.65%) were labeled only with a case number. Before using the nasal sprays, two points were considered: first, do not shake the sprays; second, prime the sprays by pumping five actuations into the air.[8]

2.1 | Anesthetic management

All the patients received nasal sprays 60 min before the induction of general anesthesia. Midazolam (1 mg, intravenously) was used to premedicate before anesthesia. General anesthesia was induced with propofol (2.5 mg/kg), fentanyl (2 μg/kg), lidocaine (20–40 mg), and cisatracurium 0.1–0.2 mg/kg. Anesthesia was maintained with remifentanil (0.1 μg/kg/min) and propofol (50–150 μg/kg/min) until systolic blood pressure was brought between 80 and 100 mm Hg; then, remifentanil infusion rate was adapted to maintain hypotension at this level. All the patients were placed in a 20-degree reverse Trendelenburg position to improve venous drainage. Before beginning the surgical procedure, lateral nasal walls were infiltrated with 5–8 ml of lidocaine 1% with 1:100,000 epinephrine solution. Standard maxillary antrostomies, total ethmoidectomies, sphenoid and frontal sinusotomies were performed as indicated. No additional vasoconstrictors (e.g., topical adrenaline) were used during the surgery. If the surgeon had troublesome bleeding intraoperatively, patient was excluded from the study. Under these circumstances, a sensitivity analysis (worst case scenario) was used. This was accomplished by assigning the worst possible outcomes for the missing data in the group with best results and the best possible outcomes in the group with the worst results

2.2 | Outcomes

The present study aimed to evaluate the efficacy of varying doses of topical desmopressin against placebo on intraoperative bleeding during FESS. The primary outcomes were the volume of blood loss and quality of the surgical field. Intraoperative bleeding was estimated with a suction bottle graded with the precision of 10 ml. Blood loss was measured by subtracting the amount of saline solution used to irrigate the surgical field from the amount of blood and fluids aspirated from the surgical field. All nasopharyngeal sponges were weighed at the end of the surgery, and each 1 g increase in pack weight was taken as 1 ml of blood loss. The quality of the surgical field was assessed by the Boezaart grading system, which is a five-point scale (from "no bleeding": 1, to "severe bleeding with constant suctioning required": 5).[15] After the surgical dissection was completed on each side, the surgeon recorded the intensity of bleeding experienced during the dissection according to the Boezaart grading scale. Blood and urine sodium were measured in the first 6 h after surgery. Any adverse events were recorded until 24 h after surgery

2.3 | Sample size

The sample size for the study was estimated using G*power, version 3.1.9.2, by taking 5% margin of error and 95% confidence interval. According to Haddady's study,[16] the mean quality of surgical field in the desmopressin and control groups was 4.08 (0.62) and 4.59 (0.76), respectively. The sample size was estimated as 40 patients per group (low-dose desmopressin, high-dose desmopressin, and control groups).

2.4 | Statistical analysis

The data were analyzed using STATA 14.0 (StataCorp LP, College Station, TX, USA). Means and SDs were presented for the quantitative variables and absolute frequencies and percentages for the categorical variables. The baseline equivalence of demographic and clinical characteristics were assessed among the three groups. A standardized mean difference (Hedges' g) was used for the continuous variables and the Cox index was used for the dichotomous variables as an effect size to determine whether there was baseline equivalence between the intervention and comparison groups. If the absolute baseline effect size was between 0.05 and 0.25, the statistical analyses were adjusted such as to satisfy the baseline equivalence.[17] Differences in the volume intraoperative bleeding between the groups were tested using an Analysis of Variance/Covariance (ANOVA/ANCOVA) with a subsequent Scheffe post hoc test.

The quality of the surgical field variable was taken as a binary variable (clean field: score 1–2; bloody field: score 3–5), and this variable was separately compared between the three groups for both sides. For assessing the effect of the different interventions on this binary outcome, modified Poisson regression with robust variance was performed. The independent variables included polyposis, the Lund-Mackay score, and the interventions (low-dose/ high-dose desmopressin vs control groups). The results were expressed as risk ratio (RR) and risk difference (RD), with a 95% confidence interval (95% CI). The adjusted number needed to treat (NNT) and 95% confidence intervals were then computed by inverting the adjusted RD and its 95% confidence limits. For all the tests, the level of statistical significance was set at $p < 0.05$.

3 | RESULTS

After screening a total of 133 patients, 120 aged 18 to 60 years were randomized and included on an intention-to-treat (ITT) basis. Figure 1 demonstrates the flow of patients through the trial according to the consolidated standards of reporting trials statement. Table 1 shows the patient characteristics at baseline. As demonstrated in the table, there were no statistically significant differences between the groups concerning the baseline parameters. The analysis showed all absolute effect sizes as less than 0.25. The baseline characteristics were thus equivalent among the intervention and placebo groups (Table S1). Among the variables with effect sizes more than 0.05, polyposis and Lund MacKay score were strong confounding factors for intraoperative bleeding[18,19] and the main analyses were adjusted for these covariates.

A significant correlation was observed between the type of intervention and volume of blood loss (Table 2). There was no significant difference between the LD-DDAVP and control groups (mean difference of 0.4 ml). Nonetheless, intraoperative bleeding was 29.6 ml lower in the HD-DDAVP group than the controls. The magnitude of the corresponding effect size (adjusted for polyposis and Lund-Mackay score) was −1.02, which is interpreted as a large effect.

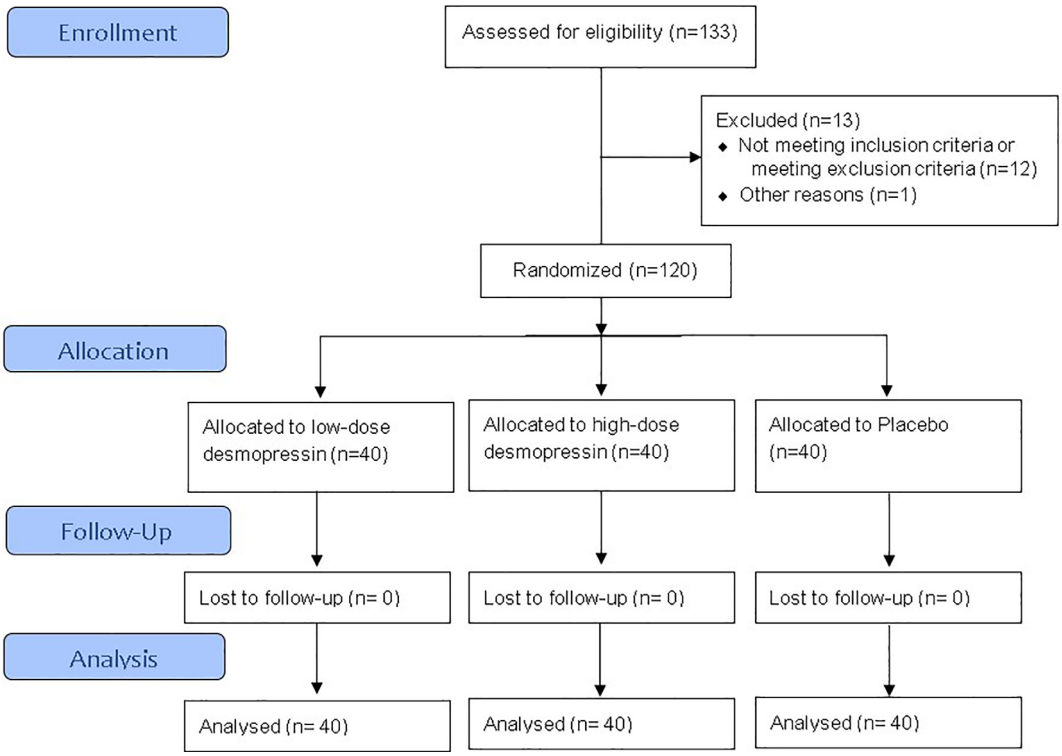

FIGURE 1 Patient flow diagram in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines.

TABLE 1 Baseline demographics

	LD-DDAVP ($n = 40$)	HD-DDAVP ($n = 40$)	Placebo ($n = 40$)	All Patients ($n = 120$)	*P* value LD-DDAVP vs. Placebo	*P* value HD-DDAVP vs. Placebo
Age, year[a]	41.4 (10.8)	39.5 (11.4)	42.1 (9.9)	41.0 (10.7)	.75	.28
Female, *n* (%)	15 (37.5)	13 (32.5)	12 (30.0)	40 (33.3)	.48	.81
CRSwNP, *n* (%)	30 (75.0)	33 (82.5)	32 (80.0)	95 (79.2)	.59	.78
Lund-Mackay Score	19.8 (3.6)	20.4 (3.1)	19.8 (3.6)	20.0 (3.5)	.93	.43
Hemoglobin, mg/dl	13.6 (1.6)	13.4 (1.5)	13.8 (1.8)	13.6 (1.6)	.59	.24
Blood Na level, mEq/L	135.9 (2.6)	136.7 (3.1)	136.5 (3.0)	136.3 (2.9)	.33	.83
Urine Na level, mEq/L	24.4 (3.1)	24.0 (2.5)	23.7 (2.8)	24.04 (2.8)	.35	.62
SBP, mmHg	117.3 (11.5)	118.0 (11.4)	115.8 (11.1)	117.0 (11.3)	.56	.37
DBP, mmHg	77.0 (6.4)	76.3 (5.2)	75.6 (9.1)	76.3 (7.1)	.44	.71
Duration of surgery, min	118.3 (16.3)	111.3 (14.9)	120.8 (18.0)	116.8 (16.8)	.52	.01

Abbreviations: CRSwNP, chronic rhinosinusitis with nasal polyposis; DBP, diastolic blood pressure; HD-DDAVP, high-dose desmopressin; LD-DDAVP, low-dose desmopressin; min, minutes; SBP, systolic blood pressure.

[a]Data are given as mean (SD) except where noted. To determine equivalence of baseline characteristics, we used *t*-test for continuous variables and chi squared for dichotomous variables.

There was a correlation between the type of intervention and the quality of surgical field at the first and second time points (at the end of the first and second surgical sides, respectively). According to the Boezaart grading scale, no subject in the three groups had a score of five at both time points and was excluded from the analysis. Better quality of surgical field was not found more frequent in the LD-DDAVP group compared to the control group at both time points. The confidence intervals showed the uncertainty of these estimates (Table 3). At the first and second time points, the difference of probability of having a clean surgical field in the HD-DDAVP and control groups was 63.5% (95% CI: 31.6%–95.3%) and 78.1% (95% CI: 34.8%–121.5%), respectively. This represents a number needed to treat (NNT) of 2 patients to prevent 1 bloody event (score ≥3 in the Boezaart grading scale)

TABLE 2 Comparison intraoperative bleeding (ml) between low-dose desmopressin (LD-DDAVP), high-dose desmopressin (HD-DDAVP) and placebo

Model	LD-DDAVP ($n = 40$)[c]	HD-DDAVP ($n = 40$)[c]	Placebo ($n = 40$)[c]	Mean Difference[d]	Cohen's d[d]	Partial eta2	p value
Crude	155.5 (44.5)	141.0 (23.1)	156 (39.8)			0.035	.124
LD-DDAVP vs. placebo				−0.5 (−20.9, 20.0)	−0.01(−0.45, 0.42)		
HD-DDAVP vs. placebo				−15.0 (−35.5, 5.5)	−0.40 (−0.85, 0.04)		
Adjusted A[a]	159.6 (32.7)	138.4 (32.5)	154.5 (32.4)			0.073	.012
LD-DDAVP vs. placebo				5.0 (−13.1, 23.2)	0.16 (−0.28, 0.60)		
HD-DDAVP vs. placebo				−16.1 (−34.1, 1.9)	**−0.50 (−0.94, −0.05) [P = 0.03]**		
Adjusted B[b]	160.1 (26.2)	132.7 (26.4)	159.7 (26.3)			0.194	<.001
LD-DDAVP vs. placebo				0.4 (−14.1, 15.0)	0.02 (−0.42, 0.45)		
HD-DDAVP vs. placebo				**−26.9 (−41.7, −12.2) [P < 0.001]**	**−1.02 (−1.49, −0.56) [P < 0.001]**		

Note: Blood loss (ml) was estimated by suction drain and blood sponges.
[a]Adjusted for polyposis.
[b]Adjusted for polyposis and Lund-Mackay score.
[c]Mean (SD).
[d]Effect size (95% confidence interval).

TABLE 3 The effect of low-dose desmopressin (LD-DDAVP), high-dose desmopressin (HD-DDAVP) on the quality of surgical field outcome compared to placebo (reference)[a]

Time point	Model	Frequency of clean field, *n* (%)			Crude risk ratio[b]	Model A Risk ratio (95% CI)[b]	Model B Risk ratio (95% CI)[c]
		LD-DDAVP	HD-DDAVP	Placebo			
First surgical side	LD-DDAVP vs. placebo	20 (50.0)	39 (97.5)	22 (55.0)	0.91 (0.60, 1.38)	0.89 (0.59, 1.34)	0.91 (0.63, 1.31)
	HD-DDAVP vs. placebo				**1.77 (1.33, 2.36) [P = 0.03]**	**1.79 (1.36, 2.35) [P = 0.03]**	**1.89 (1.45, 2.45) [P =0.01]**
Second surgical side	LD-DDAVP vs. placebo	23 (57.5)	35 (87.5)	17 (42.5)	1.35 (0.86, 2.12)	1.34 (0.86, 2.09)	1.36 (0.90, 2.06)
	HD-DDAVP vs. placebo				**2.06 (1.41, 3.01) [P = 0.02]**	**2.07 (1.42, 3.01) [P = 0.01]**	**2.18 (1.53, 3.11) [P < 0.01]**

Abbreviation: CI, confidence interval.
[a]Clean surgical field: score 1–2 in the Boezaart grading scale.
[b]Model A: adjusted for polyposis.
[c]Model B: adjusted for polyposis and LMS.

over surgery (first time point: 1.6, 95% CI 1.1–3.2; second time point: 1.3, 95% CI 0.8–2.9).

The mean total time of surgery was shorter in the intervention groups (118.3 min in the LD-DDAVP group and 111.3 min in the HD-DDAVP group) than the control group (120.8 min). After adjusting for polyposis and Lund-Mackay score, the ANOVA/ANCOVA revealed a significant difference in this variable between the three groups ($p < 0.001$). Scheffe's post hoc comparison showed only a significant difference between the HD-DDAVP and control groups (mean difference: 11.3 min, 95% CI: 4.4–18.2 min, $p < .001$). No clinically relevant differences were observed among the three groups in terms of the hemodynamic profiles (systolic and diastolic blood pressure). Mean plasma sodium values on admission to recovery room and mean urinary sodium values on the first day of postsurgery were similar among the three groups (*Ps* >0.05).

4 | DISCUSSION

It is uncertain whether DDAVP improves or worsens total blood loss, because the quality of evidence on this subject is very poor.[20] It has been shown that desmopressin can reduce blood loss during septorhinoplasty.[16] This prospective randomized study evaluated the effect of

two different doses of intranasal desmopressin (20 μg and 40 μg) on intraoperative blood loss and the quality of surgical field in FESS compared with placebo. As for LD-DDAVP, there were no significant intervention effects on the volume of intra-operative bleeding or clean surgical field rates in endoscopic sinus surgery (effect size d: 0.02, 95% CI: −0.42–0.45 for blood loss; RR: 1.34, 95% CI: 0.86–2.09 for clean surgical field). This finding is contrast to the results of previous trials.[9,10] One possible explanation could be that the lower degree of chronic rhinosinusitis in the previous trials (fewer participants with CRwNP or high points of Lund-Mackay score) has caused the substantial bleeding in FESS. It is well-known that Lund-Mackay score and polyposis are strong predictors of bleeding in endoscopic sinus surgery.[18,19] In addition, the presence of polyposis and more severe disease can interfere with the local absorption of the drug. It should be noted that the bioavailability of desmopressin delivered intranasally is 5%–10%.[21] Therefore, it seems appropriate that the analyses have been adjusted for these confounders in our study. Furthermore, HD-DDAVP caused significantly better outcomes compared to the placebo. The results showed that on average, the volume of bleeding in the HD-DDAVP patients was reduced by 26.9 ml, yielding an effect size of about one. The mean difference and standardized mean difference (Cohen's d) are both important indexes. The mean difference provides information in clinical units and Cohen's d provides information in statistical units. Given that the two groups were normally distributed and equal in size and variability, when effect size is 1, the overlap between the distributions is only about 45% and the difference between the groups becomes very obvious.[22] This difference is higher than the measurement error of blood loss (10 ml). Although the mean difference of this variable might seem unimportant, delicate anatomic landmarks and magnification must be taken into account in endoscopic sinus surgery. Minor bleeding can compromise the surgical field and the surgeon's ability to visualize anatomical landmarks, which is an important cause of iatrogenic morbidity (including vascular or nerve damage and cerebrospinal fluid leakage). Although the amount of bleeding is important, it depends on the stage of the surgery and the specific anatomical region. Moreover, preoperative HD-DDAVP offered better quality of surgical field as well as better surgeon satisfaction during FESS. In this group, the probability of having a good surgical field over time was about two times higher than in the placebo group (RRs for first and second surgical sides: 1.89 and 2.18; *P*s <0.05). This finding was independent of hemodynamic variables, and the observed clinical effect may be attributed to the hemostatic effects of desmopressin. These effects of DDAVP allowed the better visualization of the surgical field, resulting in a shorter duration of the procedure as well. This finding may have important clinical implications.

The mean duration of surgery was about 3 and 10 min less in the LD- and HD-DDAVP than the placebo group, which reflects the benefits of DDAVP for individual patients; however, this amount of time saved is not clinically significant.

The optimization of surgical conditions for FESS is multifactorial. Achieving a bloodless field is not without its risks and is generally accomplished via interventions that have a significant impact on hemodynamic stability. It is postulated that the desmopressin-induced increases in Factor VIII (FVIII) and vWF are mediated by low-affinity, extrarenal V2 receptors. The proposed sites of these receptors include endothelial cells, megakaryocytes, blood monocytes, and mast cells. Increasing vWF levels for people undergoing surgery or invasive procedures may reduce the volume of blood loss (or may prevent blood loss completely) and may consequently reduce the need for red cell transfusion. VWF levels often rise naturally in response to stressful stimuli such as surgery, and the benefits of increasing vWF levels with DDAVP may vary according to baseline vWF levels. Increased FVIII and vWF levels are thought to be due to their release from endogenous reservoirs and not increased synthesis, since the response is so rapid. Intranasal desmopressin has an antidiuretic effect of about one-tenth that of an equivalent dose administered by injection. Peak plasma concentrations are noted within 40 to 45 min of a dose. Increased FVIII activity is noted 30 min after intranasal administration, with peak activity occurring in 90 min–2 h. Intranasal desmopressin 300 μg results in maximal FVIII and vWF activity levels 150% to 250% of the normal. The initial and terminal half-lives for desmopressin are 7.8 and 75.5 min, respectively, resulting in a prompt onset of action with a long duration of action. Desmopressin is excreted via the kidneys.[8]

Desmopressin may theoretically predispose patients to thrombotic events. Thus, its use in patients with a hypercoagulable state should be carefully justified. Contraindications of desmopressin include unstable coronary artery disease[23] and questionably type IIB von Willebrand disease.[24] This study excluded those with a history of ischemic heart disease, hypertension, or cerebrovascular disease. No postoperative thromboembolic complications were observed among the patients.

Desmopressin has a 60% higher affinity than antidiuretic hormone for the V2 receptor and may therefore be associated with fluid retention. In this study, blood and urine sodium levels were recorded in the first 6 h after surgery, and the results showed no significant differences between the three groups. Previous studies have shown that the antidiuretic effect of desmopressin has been minor and hyponatremia is more likely to occur with repetitive dosing or in young children.[25,26] This finding is in line with the reports by Shao et al.[12] Although clinical studies have reported undesirable effects for desmopressin, such as hypertension, headache, water intoxication with hyponatremia, hyponatremic convulsions, and abdominal cramps,[8] all these instances have been reported when taking the therapeutical dose (at least 20 μg a day) and for longer than 10 weeks.[26]

One limitation of this study was the use of a subjective scale to evaluate the quality of the surgical field and also the satisfaction of the surgical team. Although Boezaart grading system is valuable, the majority of surgical fields fall in the range of 1–4. Therefore, there are trends to compress the grading system that causes differentiation of more subtle changes to be difficult. The Wormald grading scale, which separates the middle grades, is a more accurate grading tool to evaluate surgical field in FESS. Measuring blood loss from aspirated contents is somewhat inaccurate because irrigation fluids are collected in

suction bottles along with saline, tissue, and blood. Given the lack of a gold standard to directly measure blood loss, the method used in this study was designed to optimize blood loss collection and to minimize unquantifiable losses.

In conclusion, the present study demonstrated that DDAVP results in less bleeding and a better surgical condition for patients undergoing FESS. Also, no complications arose in this study with the use of intranasal desmopressin. The participants can be deemed representative of adult patients with primary chronic rhinosinusitis in Iran. Further studies are needed to investigate the safety of HD-DDAVP in different age groups and difficult cases, such as allergic fungal sinusitis, nasal polyposis, or revision surgery, to determine the reliability and applicability of this intervention in performing FESS. The efficacy of varying doses of DDAVP should also be evaluated in clinical practice. Further studies are recommended to generalize these results to other procedures such as adenotonsillectomy, septoplasty, and turbinate surgery.

ACKNOWLEDGMENT

Grants from the Guilan University of Medical Sciences, Rasht, Iran. The authors would like to thank the patients for taking part in this study.

FUNDING INFORMATION

Guilan University of Medical Sciences, Rasht, Iran (Grant Number: 2263).

CONFLICT OF INTEREST

The authors declare that no competing interests exist.

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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: Akbarpour M, Jalali MM, Akbari M, Haddadi S, Fani G. Effect of desmopressin on bleeding during endoscopic sinus surgery: A randomized clinical trial. *Laryngoscope Investigative Otolaryngology*. 2022;7(4):920-927. doi:10.1002/lio2.841