Is Pterygopalatine Fossa Injection with Adrenaline an Effective Technique for Better Surgical Field in Fess?

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Abstract Functional endoscopic sinus surgery (FESS) is one of most common surgeries in otorhinolaryngology practice. It is done in the narrow confines of the nasal cavity. Bleeding into the surgical field is a major problem faced by endoscopic surgeons. To assess the effectiveness of pterygopalatine fossa infiltration with lignocaine and adrenaline in controlling surgical field bleeding during endoscopic sinus surgery. A randomized blinded study was done among 68 patients who underwent FESS. Infiltration with 2% lignocaine with 1:80,000 adrenaline was given only on one side and the surgeon was blinded as to which side was infiltrated and he was asked to assess the surgical field using a standard scale. There was statistical significant improvement in surgical field on the infiltrated side ($p = 0.001$) with almost 25–30% improvement in surgical field on the infiltrated side. The surgical field bleeding also varied with the blood pressure with a positive correlation. There were no complications associated with the procedure. Pterygopalatine fossa infiltration with lignocaine and adrenaline is an effective technique in reducing surgical field bleeding during FESS. It can be combined with nasal decongestion or hypotensive anaesthesia for an optimum surgical field.

Keywords Pterygopalatine fossa · Lignocaine · Adrenaline · Endoscopic sinus surgery

Introduction

Endoscopic surgery is a minimally invasive technique that has found place in almost all fields of surgery. However, intraoperative bleeding constitutes a major drawback to endoscopic visualization. This will in turn lead to increased risk of complications, including brain injury, orbital or optic nerve injury, and catastrophic bleeding from major vessels (e.g., internal carotid artery) [1]. This is particularly problematic in patients with severe infections and when there is extensive nasal polyposis. Thus, obtaining adequate hemostasis has a major role in providing an optimum surgical field and reducing associated complications [2]. Methods to reduce intra-nasal bleeding, such as keeping the head end elevated during surgery to reduce intra nasal bleeding, nasal wall epinephrine administration [1], bradycardia induced during surgery [2], nasal packing with decongestants and inducing low blood pressure through fast-acting β -blocker or magnesium administration during surgery [3] or α -agonist administration before surgery [4, 5] or selection of appropriate anaesthesia to reduce intra-nasal bleeding have been tried with varying success [6].

Pterygopalatine fossa infiltration with vasoconstrictors and local anesthesia via the greater palatine foramen has been described in the literature. Vasoconstrictors infiltrated into this space will act on the third part of the maxillary artery as it enters the pterygopalatine fossa. This will in turn cause vasospasm of the maxillary artery and thereby decreasing the amount of blood flow into the sphenopalatine artery, which causes a reduction in the blood flow to the nasal cavity mucosa [5, 7, 8]. In the present study we studied effectiveness of pterygopalatine fossa infiltration with lignocaine and adrenaline in controlling surgical field bleeding during endoscopic sinus surgery.

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Materials and Methods

A prospective blinded clinical study was conducted over a period of 2 years from October 2012 to September 2014. All patients undergoing FESS with bilateral disease were included in the study as confirmed by computed tomography of the paranasal sinuses. Patients who have asymmetrical disease, hypertension, bleeding disorders, are on anticoagulant therapy, hypersensitive to lignocaine were all excluded from the study.

In the study, each patient acted as their own control as only one side was infiltrated. The side of infiltration was selected randomly and the surgeon doing the procedure was blinded as to which side was infiltrated. An informed consent was obtained from all patients included in the study and the study was approved by Institutional Ethics Committee.

After the patient was intubated orally by the anaesthetist, the vital signs and all anaesthetic parameters were kept as constant as possible for the duration of the surgery. Cotton neuropatties soaked in 5 ml of solution (30 ml of 4% lignocaine with 3 ampules of 1 ml 1:1000 adrenaline) were placed in the sphenoethmoidal recess, middle meatus, and in the anterior end of the middle turbinates on either side of the nose for at least 5 min before the start of the procedure. The pterygopalatine infiltration was performed by introducing a 26-gauge 1^{1/2} needle into the greater palatine foramen and traversing the greater palatine canal into the pterygopalatine fossa [9]. The needle was bent at 20 mm and inserted into the greater palatine canal until the bend. The bending of the needle will prevent over penetration and consequently the potential complications. The average length of the greater palatine canal is 18.5 mm and the bending of the needle limited penetration of the needle into the pterygopalatine fossa and consequently lessened potential complications [10]. The greater palatine foramen is located by placing a finger in the mouth and palpating junction of the hard and soft palate. The finger is drawn anterior to the posterior rim of the hard palate for 3–5 mm until the foramen is felt [5]. The foramen usually lies in the transverse line drawn from the posterior margin of the second upper molar to the other side. After insertion of the needle, 2 ml of 1:80,000 solution of adrenaline with 2% lignocaine was infiltrated into the pterygopalatine fossa after aspiration. The successful infiltration was confirmed by blanching of the mucosa around the greater palatine foramen in oral cavity.

After commencement of surgery, the surgeon is asked to grade both the surgical field every 15 min using a standard Boezaart and van der Merwe scale [11] (Table 1). Blood pressure and pulse rate were also monitored along with the

grade. The surgeon was asked to alternate the side of surgery every 30 min.

The sample size for the study was calculated with a power of 90% and confidence level of 95%. The statistical analysis was done using SPSS version 11.5. The collected data was analysed by using Mannwhitney test to compare between nasal pathologies and Wilcoxon signed rank test to analyse blood pressure variables. A *p* value < 0.05 was considered statistically significant.

Results

Our study included 68 patients who underwent functional endoscopic sinus surgery (FESS). The study subjects were given infiltration by the standard greater palatine approach on one side which acted as the case side and the other side acted as a control for comparison. The side of infiltration was randomly selected. The surgeon was asked to grade the surgical field every 15 min and the grading was done using a standard Boezaart and van der Merwe scale. The study is a blinded study in which the surgeon is unaware as to which side is infiltrated. In our study we also recorded the blood pressure and heart rate every 15 min to study the correlation between blood pressure and bleeding.

In our study, we had more of a middle aged population. The youngest in our study was 23 years and oldest in our study was 46 years. The mean age of our study population was 33 years.

Among the 68 patients included in our study, 30 were females and 38 were males.

Nasal Pathologies

Among the 68 patients included in our study 38 patients had chronic sinusitis, 27 patients had sinonasal polyposis and 3 patients had fungal sinusitis. The distribution of patients is depicted in the table given below (Table 2).

Effect of Infiltration

In our study, of the 68 patients who were infiltrated, 63 patients (93%) showed an improvement in surgical field on the infiltrated side, 3 patients (4%) had almost similar surgical fields on both the infiltrated as well as the non-infiltrated side, 2 patients (3%) had better field on the non-infiltrated side.

Grading of Surgical Field

The grading of surgical field was done using a standard Boezaart and van der Merwe scale. The grading of surgical field was significantly better on the infiltrated side

Table 1 Boezaart and van der Merwe Scale for endoscopic grading of bleeding [11]

Grade	Assessment
0	No bleeding (cadaveric conditions)
1	Slight bleeding— <i>no</i> suctioning required
2	Slight bleeding— <i>occasional</i> suctioning required
3	Slight bleeding— <i>frequent</i> suctioning required; bleeding threatens surgical field <i>few seconds</i> after suction is removed
4	Moderate bleeding— <i>frequent</i> suctioning required and bleeding threatens surgical field <i>directly after</i> suction is removed
5	Severe bleeding— <i>constant</i> suctioning required; bleeding appears faster than it can be removed by suction; surgical field severely

Table 2 Diagnosis distribution

Nasal pathology	Frequency	Percentage
Chronic sinusitis	38	55.9
Fungal sinusitis	3	4.4
Sinonasal polypsis	27	39.7
Total	68	100.0

compared to the non-infiltrated side ($p = < 0.001$). The minimum grade on the infiltrated side was 2 and the maximum grade was 4. The minimum grade on the non-infiltrated side was 3 and the maximum was 5. The average grade on the infiltrated side was 2.2 and on the non-infiltrated side was 3.2 (Fig. 1). There were higher grades of bleeding in patients with fungal sinusitis than in patients with sinonasal polypsis or chronic sinusitis.

The Table 3 shows comparison of the surgical field grades of all the patients between the infiltrated side (i.e., cases) and non-infiltrated side (i.e., controls). The mean value of the minimum and maximum grades were obtained at each 15 min interval for the infiltrated and the non-infiltrated side and when compared with each other, it was found to be highly significant ($p = 0.000$). The statistical significance of surgical field improvement could not be

assessed beyond 135 min of surgery as there were fewer number of patients with duration of surgery more than 135 min. The statistical significance and the distribution is given in the table below (Table 3).

Surgical Field in Different Nasal Pathologies

The average grades of surgical field at each 15 min intervals for different nasal pathologies were obtained and was compared with each other at each point of time and the values were statistically analysed. Among the patients under study when we compare the bleeding into the surgical field, the patients with fungal sinusitis was seen to have more amount of intraoperative bleed than those with chronic sinusitis which was statistically significant ($p = 0.031$). Fungal sinusitis patients also had more basal

Fig. 1 Surgical field grading

Table 3 Surgical field grading and its statistical significance

	Group	N	Minimum	Maximum	Mean	SD	Median	Mannwhitney test	<i>p</i> value
15 min	Cases	68	2.00	4.00	2.22	.48	2.00	.000	< 0.001, HS
	Controls	68	3.00	5.00	3.22	.45	3.00		
30 min	Cases	68	2.00	4.00	2.22	.48	2.00	.000	< 0.001, HS
	Controls	68	3.00	5.00	3.22	.45	3.00		
45 min	Cases	68	2.00	4.00	2.22	.48	2.00	.000	< 0.001, HS
	Controls	68	3.00	5.00	3.24	.49	3.00		
60 min	Cases	68	2.00	4.00	2.22	.48	2.00	.000	< 0.001, HS
	Controls	68	3.00	5.00	3.24	.49	3.00		
75 min	Cases	67	2.00	4.00	2.22	.49	2.00	.000	< 0.001, HS
	Controls	67	3.00	5.00	3.24	.50	3.00		
90 min	Cases	49	2.00	4.00	2.24	.52	2.00	.000	< 0.001, HS
	Controls	49	3.00	5.00	3.22	.47	3.00		
105 min	Cases	25	2.00	4.00	2.24	.52	2.00	.000	< 0.001, HS
	Controls	25	3.00	5.00	3.24	.52	3.00		
120 min	Cases	9	2.00	3.00	2.22	.44	2.00	.001	< 0.001, HS
	Controls	9	3.00	5.00	3.56	.73	3.00		
135 min	Cases	3	2.00	2.00	2.00	.00	2.00	.034	sig
	Controls	3	3.00	4.00	3.33	.58	3.00		
150 min	Cases	1	2.00	2.00	2.00		2.00	–	–
	Controls	1	3.00	3.00	3.00		3.00		

HS highly significant, sig significant

bleeding into surgical field than sinonasal polypoid patients, which when statistically analysed was also statistically significant ($p = 0.039$). Although patients with sinonasal polypoid had more bleeding into surgical field than chronic sinusitis patients, it was not statistically significant. And also as there were fewer number of patients with longer duration of surgery the statistical significance could be compared only up to 105 min. The statistical analysis and the significance is depicted in the table below (Table 4).

Surgical Field Variation with Blood Pressure

Of the 68 patients we studied, the blood pressure was also monitored for comparison with the surgical field on both infiltrated side and non-infiltrated side at 15 min intervals to know whether there is any significant correlation between blood pressure and the amount of bleeding into the surgical field. The systolic as well as the diastolic pressure variations were compared with the surgical field grades on both infiltrated and the non-infiltrated side. We found that there was significant change in the surgical field bleeding with respect to diastolic as well as systolic blood pressure (Fig. 2).

The blood pressure values obtained at every 15 min intervals were compared with surgical field grades

variation at each point of time. The table shows the statistical significance calculated after comparison between surgical grades and blood pressure at each point of time among each other (Table 5). There was a significant positive relation between intraoperative bleeding and blood pressure.

Duration of Effect

The duration of action was estimated by the maintenance of the difference in the intra-operative field grading between the infiltrated and the non-infiltrated side during the surgery. In our study, the minimum duration was for 60 min and the maximum duration was 150 min. The difference in surgical field grade was maintained in almost all cases in favour of the infiltrated side up to the maximum duration of 150 min, although a statistical significance could be obtained only up to 135 min due to fewer patients with longer duration surgeries (Fig. 3).

Discussion

Bleeding into the surgical field during endoscopic sinus surgery is a major problem which by itself can lead to complications due to poor visualisation. Deterioration in

Table 4 Comparison between different nasal pathologies

Diagnosis		Group			
		Cases		Controls	
		Mannwhitney test	<i>p</i> value	Mannwhitney test	<i>p</i> value
15 min	C/C sinusitis with fungal sinusitis	.042	sig	.031	sig
	C/C sinusitis with sinonasal polyposis	.767		.992	
	Fungal sinusitis with sinonasal polyposis	.082		.039	sig
30 min	C/C sinusitis with fungal sinusitis	.042	sig	.031	sig
	C/C sinusitis with sinonasal polyposis	.767		.992	
	Fungal sinusitis with sinonasal polyposis	.082		.039	sig
45 min	C/C sinusitis with fungal sinusitis	.042	sig	.031	sig
	C/C sinusitis with sinonasal polyposis	.767		.937	
	Fungal sinusitis with sinonasal polyposis	.082		.049	sig
60 min	C/C sinusitis with fungal sinusitis	.042	sig	.031	sig
	C/C sinusitis with sinonasal polyposis	.767		.937	
	Fungal sinusitis with sinonasal polyposis	.082		.049	sig
75 min	C/C sinusitis with fungal sinusitis	.046	sig	.034	sig
	C/C sinusitis with sinonasal polyposis	.803		.976	
	Fungal sinusitis with sinonasal polyposis	.082		.049	sig
90 min	C/C sinusitis with fungal sinusitis	.056		.026	sig
	C/C sinusitis with sinonasal polyposis	.639		.614	
	Fungal sinusitis with sinonasal polyposis	.104		.049	sig
105 min	C/C sinusitis with fungal sinusitis	.739		.519	
	C/C sinusitis with sinonasal polyposis	.489		.445	
	Fungal sinusitis with sinonasal polyposis	.269		.148	

sig significant

Fig. 2 Blood pressure and Surgical field grading

surgical field quality because of bleeding has been shown to lengthen the procedure and may increase the risk of operative complications [12]. The inability of the surgeon to visualize adequately the surgical field also contributes to

increased tissue trauma with an increased likelihood of postoperative scarring, adhesions, and recurrence of disease [13]. In literature, various methods and techniques

Table 5 Blood pressure and statistical significance

	Wilcoxon signed rank test	<i>p</i> value
<i>DBP</i>		
30 min–15 min	.000	HS
45 min–15 min	.000	HS
60 min–15 min	.000	HS
75 min–15 min	.000	HS
90 min–15 min	.003	HS
105 min–15 min	.939	
45 min–30 min	.003	HS
60 min–30 min	.002	HS
75 min–30 min	.159	
90 min–30 min	1.000	
105 min–30 min	.021	sig
60 min–45 min	.434	
75 min–45 min	.182	
90 min–45 min	.058	
105 min–45 min	.004	HS
90 min–75 min	.001	HS
105 min–75 min	.000	HS
105 min–90 min	.001	HS
<i>SBP</i>		
30 min–15 min	.000	HS
45 min–15 min	.000	HS
60 min–15 min	.000	HS
75 min–15 min	.000	HS
90 min–15 min	.002	HS
105 min–15 min	.102	
45 min–30 min	.012	sig
60 min–30 min	.000	HS
75 min–30 min	.028	sig
90 min–30 min	.097	
105 min–30 min	.135	
60 min–45 min	.174	
75 min–45 min	.956	
90 min–45 min	.026	sig
105 min–45 min	.071	
90 min–75 min	.000	HS
105 min–75 min	.001	HS
105 min–90 min	.038	sig

HS highly significant

have been tried to reduce the amount of bleeding into the surgical field in the past.

Pterygopalatine fossa infiltration with vasoconstrictors and local anaesthesia through the greater palatine foramen has been described in the literature. Surgical access to the pterygopalatine fossa was described as early as 1935 when Averbukh and colleagues described a transpalatine

technique to gain access to the sphenopalatine ganglion as well as the second part of the trigeminal nerve for the treatment of trigeminal neuralgia. Furthermore they concluded that the surgery can be performed under local anaesthesia [3]. Vasoconstrictors infiltrated into this space will target the third part of the maxillary artery as it enters the pterygopalatine fossa. This will cause vasospasm of the

Fig. 3 Study group with their respective duration of surgery

maxillary artery and decrease blood flow into the sphenopalatine artery with subsequent decrease in blood supply to the nasal cavity mucosa. Infiltration with vasoconstrictor solutions into the greater palatine foramen have been shown to significantly reduce intra-operative bleeding during endoscopic sinus surgery and septorhinoplasty and help control posterior epistaxis [7, 8]. Sensory innervation of the lateral wall of the nasal cavity is supplied by the posterior nasal branches of the maxillary nerve as well as the nasopalatine nerve (itself a branch of the maxillary nerve). The septum is supplied by the nasociliary nerve (a branch of the ophthalmic branch of the trigeminal nerve) and the nasopalatine nerve. Both the nasopalatine nerve and the posterior nasal branches of the maxillary nerve can be reached in the pterygopalatine fossa [14]. This means that the lateral wall of the nasal cavity as well as the posterior aspect of the septum can be successfully anaesthetized with local anaesthetic infiltration of the pterygopalatine fossa via the greater palatine foramen. Local anaesthetic infiltration via this route has been used successfully to provide regional anaesthesia for dental procedures as well as improve pain associated with removal of nasal packs following surgery [15]. Cadaver based anatomy studies by Douglas and Wormald suggested that a 25 gauge needle, bent at 45°, 20 mm from the tip will ensure optimal pterygopalatine fossa infiltration [10]. This will ensure maximal vasospasm of the maxillary artery as well as a nerve block of the terminal branches of the maxillary nerve, with minimal risk to the orbital contents and infra-orbital nerve [4].

There is a small learning curve for giving the block, but once expertized, it is an easy and effective technique. The length of the needle to be inserted varies in different patients, according to the thickness of the mucosa and also

the length of the bony greater palatine canal. As such the variation of the canal length as by various studies, extends between 16 and 25 mm [10]. So an average length of 20 mm should enable us successful infiltration in majority of the patients without much complications. If the needle is pierced too much it can lead to injury to maxillary artery and adrenaline solution can get absorbed leading to complications.

A total 73 subjects were included in the study, but initial five subjects were excluded due to inadequate infiltration as the learning curve of the infiltration. Two of the patients the canal was only partially patent may be because of the canal ossification as needle could not be passed beyond 10–12 mm, and the other side was infiltrated which were patent.

Age Distribution

In our study, we had more of a middle aged population. The youngest in our study was 23 years and oldest in our study was 46 years. The mean age of our study population was 33 years. In the study by Wormald et al. [5], the mean age was 55 years with a range from 20 to 78 years and mean age group in other studies by Yoo et al. [16] was 35 years, and by Alimian et al. [17] was 38 years.

Nasal Pathologies

Various nasal pathologies were operated upon in our study. The most common nasal pathology was chronic sinusitis which constituted 55% (n = 38) of the total study population. Other pathologies included sinonasal polyposis which constituted 40% (n = 27) and fungal sinusitis which constituted 5% (n = 3) of the study population. In other

studies, a comparable population of nasal pathologies were included. In the study by Wormald et al. [5], there were more number of patients with fungal sinusitis.

Effect of Infiltration

Of the 68 patients studied, there was improvement in surgical field on the side of infiltration in 63 patients (positive), 3 patients (equivocal) had almost similar surgical fields on both the infiltrated as well as the non-infiltrated side, 2 patients (negative) had better field on the non-infiltrated side. This may be because of the initial inadequate infiltration due to less expertise with giving the infiltration, and also few of these patients who had negative or equivocal effect were revision surgeries.

Surgical Field Improvement

The surgical field improvement we achieved in our study was in the range of 25–30% in comparison with a study by Wormald et al. [5], and Blackwell et al. [18], where more than 30% improvement in surgical field was noted, maybe because of multiple surgeons doing the procedure in our study.

Surgical Grade

In our study we used a standard Boezaart and van der Merwe scale [11] for grading of the surgical field. The surgeon was asked to grade the surgical field every 15 min to increase the accuracy of assessment. The surgical field was alternated every 30 min to increase the accuracy of assessment. We also took care to match the number of cotton patties kept on each side during the surgery and also the duration for which the patties were kept to minimise the confounding effect of the patties on the surgical field. There was a constantly better surgical field which was present throughout the duration of the 150 min. The surgical field is affected by multiple factors. A high blood pressure can lead to increased blood flow by opening up of new capillaries to the nasal cavity and in turn can lead to more bleeding into surgical field. Also patients who have been taking anticoagulants in whom surgery is done can have excessive bleeding into the surgical field due to ineffective clotting mechanisms. So in order to avoid all these confounding factors, we have tried to exclude all other such conditions which can indirectly contribute to bleeding.

Surgical Field in Different Nasal Pathologies

In our study we also tried to assess the variation in intra-operative bleeding with different nasal diseases. The

average grades of surgical field at each 15 min intervals for different nasal pathologies were obtained. The intraoperative bleeding was altogether more in patients with fungal sinusitis than in patients with sinonasal polyposis or chronic sinusitis on comparison between them at each point of time. This maybe because in infective pathologies, the mucosa is inflamed and there is increased vascularity of the mucosa and friable capillary walls & increased capillary permeability. The basal bleeding of chronic sinusitis was graded up to a maximum of 4 and there was about 20–25% improvement in surgical field. The basal bleeding in sinonasal polyposis patients also was in the range of grade 4 and also showed an improvement of 20–25%. In patients with fungal sinusitis, the maximum basal bleeding noted on the non-infiltrated side was up to grade 5 which was higher than other nasal pathologies, but, the infiltrated side showed a comparative 25–30% improvement in surgical field. This was also noticed in a study by Wormald et al. [5], where there was more intra-operative bleeding in patients with fungal rhinosinusitis than in patients with sinonasal polyposis or chronic sinusitis.

Surgical Field Variation with Blood Pressure

The intraoperative bleeding was also seen to vary with changes in diastolic as well as systolic blood pressure as seen by varying in the surgical field grade symmetrically on both sides intra-operatively with varying blood pressure. When we statistically analysed these variations, we found that there was significant correlation between blood pressure variation and surgical field in our study, when compared to study by Wormald et al. [5], and Ahn et al. [19], where there was no correlation between surgical field and blood pressure.

Duration of Effect

The duration of surgery ranged from 60 to 150 min with a median surgical time of 110 min. The surgical field improvement was seen in grading scale up to a maximum of 150 min, but, statistical significance could be analysed only till 135 min due to fewer number of patients with longer duration of surgery in comparison with Wormald et al. [5], in which they could demonstrate the action lasting up to 200 min, but the reduction of effect of infiltration over time was mentioned in their study. The operation time has also been reported as having an effect on the surgical field [20], which may be due to an increase in vasodilation with operation time as well as an increase in the surface area of the damaged tissue [16].

Complications

3 of the patients had developed tachycardia immediately following the infiltration but it subsided by itself within 5–6 min without any active intervention. It may have because of injury to vessel in the greater palatine canal or inadvertent injection into the maxillary artery or one of its branches and some amount of absorption into the circulation of adrenaline solution.

There were no postoperative pain noticed on the side of infiltration or any ulceration locally at the infiltration site. Previous studies have shown some risk of paraesthesia over the face due to infiltration injury to maxillary nerve and also risk of development of visual field defect due to vasoconstriction of the infra-orbital artery (which is branch of maxillary artery). The canal provides direct access to the contents of the pterygopalatine fossa, including the sphenopalatine ganglion, pterygopalatine ganglion, infra-orbital nerve, internal maxillary artery, and the pterygoid venous plexus [10]. Because of the direct communication of the PPF with the infraorbital fissure and the close relationship of these structures to the greater palatine foramen (GPF), this injection carries a significant risk of complications. These may include intravascular injection with associated cardiovascular side effects, blindness [21] due to vasoconstriction of the ophthalmic artery, infraorbital nerve injury [22], PPF and/or infratemporal fossa abscess, and meningitis [10, 23, 24]. But no such complications were encountered postoperatively in our study subjects.

In the study by Wormald et al. [5], no complications were mentioned as such. In a study using local vasoconstrictors by Riegle et al. [25], patients had systemic side effects like increase in BP and HR, headache. In another study by Blackwell et al. [18], where he used propofol for maintenance of general anesthesia there was decreased cerebral circulation and loss of baroreflex. Post-operative morbidity was found to be less with our technique as compared to a study by Alimian et al. [17] where preoperative transaxemic acid injection led to side effects like nausea, vomiting, and, increased risk of postoperative thrombosis.

So comparatively pterygopalatine infiltration, once mastered, is a safe technique in improving surgical field during endoscopic sinus surgeries with minimal intra-operative as well as postoperative morbidity.

Limitations

The limitations of our study include that there were 6 patients with revision surgeries and in these patients there were other factors like differential scarring and fibrosis and loss of normal anatomy which contributed to increased intraoperative bleeding and also assessment was inaccurate

as there is no symmetry in extent of scarring and fibrosis in both nasal cavities. Another limitation is that, as an institutional study, different surgeons were doing the surgeries and there was difference in objective assessment of the surgical field among the surgeons. Then the infiltration given was not the only method used by surgeons during the procedure. Different surgeons used different concentrations of adrenaline soaked cotton patties for nasal packing in between the surgical procedure. But we have tried to compensate by using similar number of cotton patty application bilaterally for similar duration as far as possible.

Conclusion

The use of pterygopalatine fossa infiltration with lignocaine and adrenaline gives a comparatively better surgical field and visualization during FESS. It has minimal intra-operative as well as post-operative morbidity compared to other systemic drug trials for the reduction in bleeding. The effect was seen to last for 2.5 h, which is more than the average FESS duration. However, as with any invasive technique, there is a learning curve for performing the infiltration.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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