Original Research Article

Study of cardiovascular effects of occlusive nasal packing versus minimal packing following nasal surgeries

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Abstract

This study was performed to compare cardiac effects of completely occlusive nasal packing with minimal packing in patients undergoing nasal surgeries. A total of forty patients were studied. Twenty patients were given a totally occlusive nasal pack and twenty patients had minimal packing. All patients underwent 24 hour holter monitoring and SAECG pre and postoperatively. In holter monitoring there was a significant increase in minimum and maximum heart rates in the patients in group 2 (patients with minimum packing). Heart rate variability studied by spectral analysis showed a significant increase in HF domain in both the groups indicating an increase in parasympathetic stimulation in both the groups. The intergroup difference was statistically not significant. There was a decrease in the LF domain noted in the group 1 but an increase in the same in group 2. This indicates an increase in the sympathetic stimulation in the group 2 which can also explain a greater increase in the minimum and maximum heart rates in group 2. There was no statistical difference between the two groups. There was no arrhythmia noted in either group pre or post operatively. The QRSD and RMS40 studied in SAECG did not show any statistical difference between the two groups. Increased parasympathetic stimulation in both the groups can be explained by the nasocardiac reflex. A greater increase in the minimum and maximum heart rates in group 2 shows possibly lesser magnitude of vagal stimulation in this group due to minimal pressure on the nasal mucosa. No changes in SAECG parameters can be explained by a relatively lesser sympathetic stimulation in both the groups. We concluded that there was no significant difference in cardiac effects between completely occlusive or minimal packing post nasal surgery in a relatively healthy patient group. This needs further evaluation with a larger study in cardiac patients.
Key Words: Nasal packs, holter monitoring, signal averaged ECG, arrhythmia.

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INTRODUCTION

Nasal surgeries are one of the most frequently performed procedures in the practice of otorhinolaryngology. This has further increased with the advent of Functional endoscopic sinus surgery (FESS) and microdebrider. Post surgery nasal packs are used to retain the elevated mucoperichondrial and mucoperiosteal flaps in position, stabilise the septum and to minimise the bleeding. It also helps in preventing formation of synechiae. Occlusive nasal packs cause nasal obstruction and force mouth breathing causing lot of discomfort to the patients. It also leads to complications like hypoxia, myocardial infarction, cerebrovascular accidents and sudden deaths[1]. The need for the use of the nasal packs post surgery has lately been questioned[3,4]. Commonly used nasal packs are ribbon gauze soaked in antibiotic ointment, glove finger filled with gauze, merocel and gelfoams[2]. Packs with airways or partially occluding support material like wax

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plates prevent total occlusion of the nasal passage. This has been shown to decrease incidence of hypoxia and its associated complications. In this study we have studied the cardiac effects of occlusive nasal packing versus minimal packing using Holter monitoring and signal averaged electrocardiogram (SAECG). The hypothesis was to see if altered autonomic cardiac modulation as assessed by holter monitoring leads to any changes in SAECG, thus predicting any predisposition to increased cardiac arrhythmias.

MATERIAL AND METHODS

This study was performed at the Department of Otorhinolaryngology and head and neck surgery at our hospital. Patients undergoing nasal surgeries like septoplasty or FESS and had nasal packing done were included in the study. Patients having major cardiac, pulmonary or other chronic comorbidities were excluded from the study. All patients underwent routine preoperative investigations including ECG and echocardiogram to rule out major cardiac illness. A detailed consent was taken from all the patients before including them in the study. The patients had a holter monitoring done for 24 hours preoperatively and an SAECG was performed just prior to surgery while patient was not on any medications and his activities were not restricted. Patients were then randomly assigned to one of the groups:

1. Occlusive nasal pack: merocel or ribbon gauze soaked in antibiotic ointment.
2. Minimal packing: wax plates.

Each patient then underwent nasal surgery either septoplasty or FESS under general anesthesia in the operating room. Post op patients were kept on oral or intravenous antibiotics and analgesics. Patiet had a holter attached immediately post surgery and SAECG was done after 24 hours at the time of holter removal. The patient's holter recording and SAECG were evaluated by a cardiologist blinded to randomisation of patients. Parameters evaluated were heart rates (maximum, minimum, average), heart rate variability using spectral analysis i.e HF power (parasympathetic activity indicator) and LF power (Sympathetic activity indicator). In SAECG, QRS duration in milliseconds (ms) and root mean square of the voltage of the last 40 ms of the QRS complex in microV (RMS 40) was noted. The preoperative and postoperative data were then evaluated and statistical analysis was done. Significance was noted using student t test and p values.

RESULTS

A total of forty patients were included in the study. Twenty patients were in Group 1 (occlusive nasal packing) and twenty patients were in Group 2 (minimal packing). Both the groups were age and sex matched. There were no significant comorbidities in patients in both the groups. Table 1 shows the holter monitoring variables in both the groups pre and post operatively. The mean preop and post op minimum heart rate was 49.15 ± 7.6 and 50.2 ± 6.5 in group 1 which was statistically not significant (t=0.48, p=0.314). The mean preop and post op minimum heart rate in group 2 was 42.3 ± 5.8 and 47.85 ± 4.5 which was statistically significant (t=3.363, p=0.0008). The difference in minimum heart rate between the group was not significant (t=-1.43, p = 0.07). The mean preop and post op maximum heart rate was 140.2 ± 14.16 and 134.85 ± 17.71 in group 1 which was statistically not significant (t=1.082, p=0.143). The mean preop and post op maximum heart rate in group 2 was 131.2 ± 7.63 and 141.45 ± 13.3 which was statistically significant (t=2.974, p=0.002). The difference in maximum heart rate between the group was significant (t=-2.47, p = 0.008). The mean preop and post op average heart rate was 74 ± 9.35 and 80.3 ± 8.7 in group 1 which was statistically significant (t=2.204, p=0.016). The mean preop and post op average heart rate in group 2 was 71.25 ± 7.04 and 71.65 ± 9.48 which was statistically not significant (t=0.206, p=0.418). The difference in average heart rate between the group was significant (t=1.71, p = 0.04). The average QT interval as measured by holter monitoring in group 1 was 353 ± 19.2 and 342 ± 19.4 preop and post op which was statistically significant (t=1.878, p=0.03). The average QT interval preop and post op in group 2 was 364 ± 22.1 and 357 ± 22.4 respectively which was statistically not significant (t=0.901, p=0.186). The difference in average QT interval in the two group was statistically not significant (t=-0.66, p=0.25). The preop and post op HF factor was 369.3 ± 259.5 and 650.6 ± 331.8 in group 1 which was statistically significant (t=2.986, p=0.002). The preop and post op values for HF were 367.5 ± 268.6 and 727.2 ± 429.44 in group 2 which was statistically significant (t=3.175, p=0.001). The difference between the two groups was not significant (t=-0.83, p=0.204). The LF factor in preop and post op patients in group 1 were 766.9 ± 397.2 and 723.7 ± 244.3 respectively which was statistically not significant (t=0.414, p=0.34). In Group 2 the values were 799.8 ± 397.6 and 893.1 ± 438.8 which was statistically not significant (t=0.584, p=0.562). The difference between the two group was not significant (t=-1.28, p=0.103). Table 2 shows the SAECG variables in both the groups pre and post operatively. The preop and post op QRSD as measured on SAECG was 99.56 ± 9.05 and 99.75 ± 9.09 for group 1 patients which was statistically not significant (t=0.946, p=0.068), whereas 96.63 ± 8.74 and 100.03 ± 9.75 for group 2 patients which was statistically not significant (t=0.25, p=1.16). The difference between the two groups was significant (t=1.97, p=0.02). The preop and post op RMS40 was 35.42 ± 19.6 and 41.7 ± 19.8 in group 1 which was statistically not significant (t=0.318, p=0.01). The preop and post values of RMS40 were 41.67 ± 17.7 and 37.4 ± 12.8 in group 2 patients which was statistically not significant (t=0.377, p=0.89). The difference between the two group was significant (t=2.45, p=0.009). Table 3 shows the comparison of t value and p values of the various variables between the groups.

Table 1: Holter monitor variables in two groups pre and post op.

	variables	Pre op	Post op	T value	P value
Group 1	Minimum HR	49.15 ± 7.65	50.2 ± 6.55	0.48	0.314
	Maximum HR	140.2 ± 14.16	134.85 ± 17.71	1.08	0.143
	Average HR	74 ± 9.35	80.3 ± 8.7	2.20	0.016
	QT average	353.5 ± 19.28	342 ± 19.44	1.87	0.030
	HF	369.3 ± 259.59	650.6 ± 331.81	2.98	0.002
	LF	766.96 ± 397.18	723.78 ± 244.27	0.414	0.340
Group 2	Minimum HR	42.3 ± 5.83	47.85 ± 4.52	3.36	0.0008
	Maximum HR	131.2 ± 7.63	141.45 ± 13.38	2.97	0.002
	Average HR	71.25 ± 7.04	71.65 ± 9.48	0.206	0.418
	QT average	364.15 ± 22.1	357.8 ± 22.45	0.901	0.186
	HF	367.56 ± 268.61	727.25 ± 429.44	3.17	0.001
	LF	799.8 ± 397.64	893.1 ± 438.8	0.58	0.562

Table 2: SAECG variable in two groups pre and post op

	Variable	Pre op	Post op	T value	P value
Group 1	QRSD (ms)	99.56 ± 9.05	99.75 ± 9.09	0.068	0.942
	RMS 40 (µV)	35.42 ± 19.59	41.7 ± 19.83	1.01	0.318
Group 2	QRSD (ms)	96.63 ± 8.74	100.03 ± 9.75	1.16	0.253
	RMS 40 (µV)	41.67 ± 17.73	37.4 ± 12.83	0.893	0.377

Table 3: Comparison of various variables between the two groups

Variables	T value	P value	Significance
Minimum HR	1.44	0.08	Not significant
Maximum HR	2.47	0.008	Significant
Average HR	1.71	0.04	Significant
QT average	0.66	0.26	Not Significant
HF	0.83	0.204	Not Significant
LF	1.28	0.103	Not Significant
QRSD (ms)	1.97	0.03	Significant
RMS 40 (µV)	2.44	0.009	Significant

DISCUSSION

Nasal breathing is superior and advantageous to mouth breathing. Nasal breathing is more physiological. Nasal passage being a small space leads to longer time for exhalation giving lungs more time for gaseous exchange. This leads to a more optimal oxygen uptake and carbon dioxide washout. Mouth breathing leads to rapid inhalation and exhalation of air leading to less time for gaseous exchange in lung. This can lead to hypoxia and compensatory increase in respiratory rate. It also reduces the depth of each breath and results in lot of dead space volume thus leading to increased energy expenditure for each breath[5]. The nasopulmonary reflex due to receptors in nasal mucosa is responsible for regulation of pulmonary resistance. This is important for regulation of breathing and is lost during mouth breathing. This is important for autonomic modulation of breathing. The nasal airflow leads to bronchial muscle relaxation and increase in respiratory activity[6-11]. In nasal surgeries anterior and posterior nasal packs are frequently used. Post surgery nasal packs are used to retain the elevated mucoperichondrial and mucoperiosteal flaps in position, stabilise the septum and to minimise the bleeding. It also helps in preventing formation of synechiae[2]. Cassie *et al.* used anterior and posterior nasal packs in 20 patients of epistaxis and demonstrated hypoxia in these patients[12]. They demonstrated an increase in bronchopulmonary tone and a decrease in pulmonary compliance with nasal packs. They concluded that nasal packs cause arterial hypoxia and thus proposed arterial ligation as preferred mode of treatment for high risk epistaxis patients. The occlusive nasal packs cause discomfort due to forced mouth breathing and pressure due to the packs also cause systemic problems. In addition to causing hypoxia it can precipitate sleep apnea or worsen hypopnea - apnea index[13]. Sudden death has also been reported in patients with posterior nasal packs for epistaxis[7]. Nonocclusive pneumatic packs were shown by Larsen and Juul to have no significant effect on alveolar ventilation[14]. There have been many studies which have studied effect of nasal packs on arterial PO2 and PCO2 levels. Hyperventilation caused due to mouth breathing leads to CO2 washout and decreased PO2, leading to hypoxia and respiratory alkalosis[15-21]. Multiple studies have compared occlusive nasal packs and packs with airflow. Serpell *et al*[19] compared 20 patients with packs causing total nasal obstruction and airflow packs following septoplasty and polypectomy. There was no difference in terms of hypoxia in the two groups but patients with airflow packs were more comfortable. Similar findings were noted by Erpek *et al*[20] and Zayyan E *et al*[21]. The two groups were not evaluated for cardiac effects in these studies. In our study we did not study the effect of occlusive or nonocclusive airway on hypoxia or carbondioxide washout. Various studies have documented cardiac arrhythmias caused due to hypoxia. Animal studies by O'Conner *et al*[22] and Giussani *et al*[23] documented ventricular extrasystoles and bradycardia respectively, caused due to hypoxia. Galatius-Jensen *et al*[24] studied 19 myocardial infarction patients with Holter and pulse oximeter to document hypoxia. Episodic hypoxia was noted leading to sinus tachycardia and other arrhythmias in 72% patients. Ogretmenoglu *et al*[17] noted no significant arrhythmia on holter in their study comparing occlusive and airflow packs. Zayyan E[21] *et al* evaluated thirty nine patients with 24 hour holter pre and post operatively to look for cardiac effects of occlusive nasal packs versus nasal pack with airway. They noticed a significant increase in minimum heart rates, significant decrease in maximum heart rates and insignificant changes in mean heart rates. They also evaluated heart rate variability to see the autonomic changes during nasal packing. An increase in high frequency (HF) domain, a decrease in low frequency (LF) domain was seen. This meant there was a decrease in sympathetic activity and an increase in parasympathetic activity, possibly due to pressure effect of nasal packs and nasocardiac reflex. No significant difference was noted between the two groups. There was no increase in cardiac arrhythmias noted. A foreign object in nasal passage induces nasocardiac reflex[25]. This reflex arc is between trigeminal nerve and vagus nerve[26,27]. This reflex stimulation leads to changes in blood pressure, bradycardia and may increase incidence of arrhythmias and cardiac arrest. Bailey *et al*[28] had reported a case of bradycardia and sinus arrest on placement of a nasal thermal probe under general anesthesia. Betelejewski *et al*[29,30)] observed apnea and arrhythmias in both normal and laryngectomized patients after treating nasal mucosa with 25% ammonia. In our study there was a significant increase in minimum and maximum heart rates in the patients in group 2 (patients with minimum packing). There was a significant increase in HF domain in both the groups indicating an increase in parasympathetic stimulation in both the groups. The intergroup difference was statistically not significant. Increased parasympathetic stimulation in both the groups can be explained by the nasocardiac reflex. A greater increase in the minimum and maximum heart rates in group 2 shows possibly lesser magnitude of vagal stimulation in this group due to minimal pressure on the nasal mucosa. There was a decrease in the LF domain noted in the group 1 but an increase in the same in group 2. This indicates an increase in the sympathetic stimulation in the group 2 which can also explain a greater increase in the minimum and maximum heart rates in group 2. This observation could not be explained. There was no statistical difference between the two groups. There was no arrhythmia noted in either group pre or post operatively. In our study we also studied the late potentials in signal averaged electrocardiogram (SAECG) to identify if there is any increase in RMS 40 (micro volt) and QRSD (ms). The postulate was that SAECG abnormalities may predict a higher incidence of arrhythmias and add complimentary information to data obtained from holter. Ahmed *et al*[31] noted in their study effect of autonomic stimulation and blockade on the late potentials on SAECG. There was an increase in late potentials with sympathetic stimulation and a decrease with sympathetic blockade. Parasympathetic stimulation or blockade did not affect the late potentials on SAECG. These findings are important since the target population for the SAECG are patients with myocardial infarction and congestive heart failure, conditions associated with increased sympathetic tone. Verzoni A *et al*[32] assessed the prognostic significance of late potentials in SAECG in patients with myocardial infarction in the first year for ventricular arrhythmias. The sensitivity of SAECGs as a predictor of arrhythmic events was 83% with a specificity of 73%. They concluded that SAECGs provide important prognostic information in identifying patients at risk of arrhythmic events after myocardial infarction. Many more studies documented the prognostic significance of SAECG in patients with myocardial infarction for predicting ventricular arrhythmias[33,34]. In our study there was no significant increase in QRSD pre or post operatively in group 1. In group 2 there was a mild increase in the QRSD although it was statistically not significant. The RMS 40 in group 1 showed an increase while in group 2 showed a decreasing trend although the difference was statistically not significant. The insignificant change in SAECG parameters can be partly explained by the fact that there was no significant sympathetic stimulation in either group. Secondly the group studied was a relatively healthy population with no cardiac morbidity and all the studies of prognostication of SAECG are on post myocardial infarction patients with systolic left ventricular dysfunction[32,33,34]. A larger study in patients with cardiac comorbidities would help decipher these issues. The nasal pack usage in old patients specially with cardiopulmonary comorbidities should be done under close observation. Minimal packing may be advantageous in view of lesser vagal stimulation and lesser discomfort as it prevents forced mouth breathing.

CONCLUSION

Nasal packing whether complete or minimal does cause an increase in vagal stimulation mostly due to nasocardiac reflex. Completely occlusive packs cause a higher vagal stimulation possibly due to pressure effect on nasal mucosa. There was no significant increase in arrhythmias noted in our study. There was no significant difference noted in the predictors of arrhythmias in either group in our study. A larger study in more cardiologically moribund patients is warranted to study the cardiac effects of completely occlusive or minimal nasal packing.

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