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Comparative study of complete nasal packing with and without airways

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Key-words. Nasal obstruction complications; post-operative; hypoxia; pulse oximetry; eustachian tube physiopathology.

Abstract. *Comparative study of complete nasal packing with and without airways*. *Objective*: To study and compare the effects of complete nasal packing and nasal packing with airways (uni/bilateral) on blood pressure, arterial oxygen saturation, middle ear pressure, and post-operative subjective complaints.
Methods: Ninety patients who underwent bilateral anterior nasal packing for epistaxis or following nasal surgery were divided into three equal groups by randomization. Group A received bilateral complete nasal packing, without an airway. In the other two groups, an airway designed from a poly-vinyl chloride, uncuffed endotracheal tube (number 5) was placed below the nasal pack between the inferior turbinate and septum on one (Group B) or both sides (Group C) of the nasal cavity. Patients were monitored in the ward when asleep, especially overnight, for blood pressure and SpO2 levels.
Results: Almost all patients in Group A had nasal obstruction with dry mouth, difficulty swallowing, and disturbed sleep. Only 33-40% patients in Groups B and C had similar complaints. Blood pressure rose >20 mm of Hg in 20 (67%) patients in Group A, while no patients in the airway groups showed any change in blood pressure. In Group A, the average SpO2 during sleep decreased >4% from baseline in 10 (33%) patients and negative middle ear pressure was found in 5 (17%) patients. The SpO2 and middle ear pressure was within normal limits for all patients with airway packing.
Conclusion: Nasal packing with an airway may help to reduce post operative morbidity and reduce the risk of hypoxemia.

Introduction

Nasal surgery is frequently performed to improve the nasal airway, ventilate sinuses, and for aesthetic corrections. Bilateral nasal packing is often done after surgery for haemostatic reasons and mechanical splinting. However, due to this packing, patients experience significant discomfort in the post-operative period from a lack of nasal breathing, ranging from headaches, snoring, and difficulty swallowing to serious life threatening complications such as pulmonary edema.[1] Nasal obstruction from the packing is also a risk factor for sleep-disordered breathing.[2] Intranasal occlusion has been found to increase both the number of apnoeas and hypopnoeas per hour of sleep and minutes of obstructive events per hour of sleep.[2] Patients with obstructive sleep apnoea syndrome (OSAS) are already at increased risk for hypoxemia and may have serious nocturnal oxygen desaturation as a result of this post-operative nasal packing.[3] Bilateral nasal packing also leads to compromised eustachian tube function and middle ear ventilation.[4]

To avoid these complications, nasal packing with an airway seems more appropriate in such patients. Although nasal packing material with an airway tube is commercially available, it is costly, inconvenient, and unstable.[5] Here, we used an airway fabricated from an endotracheal tube and placed it along the nasal packs. We compared the various complaints and morbidities experienced by patients with bilateral nasal packs with that of patients with the airway packs.

Materials and methods

Ninety patients who were to undergo bilateral anterior nasal packing for epistaxis or following nasal surgery were included in the study. A detailed relevant history was obtained and a general physical examination and oto-rhinolaryngological examination of the selected patients were completed.

Inclusion criteria:

1. Those having long term nasal discharge and headache, i.e. suffering from chronic sinusitis with no relief from medical therapy.

2. Patients with septal deviations.
3. Patients with nasal bleeding who required bilateral anterior nasal packing.

Exclusion criteria:

1. Patient having acute upper respiratory tract infections.
2. All patients with underlying systemic illnesses like cystic fibrosis or a ciliary abnormality, immunodeficiency or diabetes mellitus, tuberculosis, bleeding diathesis, hypertension, and patient with haemoglobin < 10 mg/dl.
3. Patients requiring unilateral nasal packing.

Patients were randomized into three equal groups by alternate allocation. The age, gender, preoperative medication (like steroids), and type of operation required were not taken into consideration. The doctor from the department, blinded to this data, assigned the patients continuously as they were recruited. Thus, there was no matching and the groups were not homogeneous for gender and age.

Group A: Patients with complete bilateral nasal packing.

Group B: A unilateral nasal airway was placed along with the bilateral nasal pack.

Group C: Bilateral nasal airways were placed along with the bilateral nasal pack.

The distribution of the initial pathologies, in all three groups, was noted, as shown in Table 1.

Table 1
Distribution of initial pathologies in each group

Pathology	Group A	Group B	Group C
Epistaxis	6	6	2
Chronic sinusitis	5	4	5
Ethmoidal polyposis	5	5	5
Allergic fungal sinusitis	4	6	7
Deviated nasal septum	10	9	11

In addition to routine blood and urine investigations some special tests were done:

1. Diagnostic nasal endoscopy: under local anaesthesia, using 0 degree and 30 degree rigid fibreoptic nasal endoscopes.
2. Radiology: water's view X-ray of the paranasal sinuses and/or non-contrast computed tomography scan.

Informed consent was obtained from all patients after explaining all the risks involved and the benefits of the procedure.

Surgery was performed under local anaesthesia, by infiltration of 2% xylocaine admixed with adrenaline (1:200,000), or general anaesthesia if required. The duration of general anaesthesia was not significantly different among the groups. A post-operative bilateral nasal pack, using one meter ribbon gauze and Framycetin skin cream, was placed with or without the airway. The airway was designed from poly-vinyl chloride (PVC), uncuffed endotracheal tube number 5 (Figure 1). The tube was cut into two halves and one half was placed on a single side. This airway was placed below the routine nasal pack, between the inferior turbinate and septum. The free position of the posterior opening of the airway tube was confirmed by digital pressure. Randomization determined whether the airway was placed on one or both sides of the nasal cavity (Figure 2).

Post-operatively, all patients received injections of ceftriaxone, 1 gm intravenously twice daily, along with a diclofenac-paracetamol combination tablet, in the same dosage, twice daily. Neither opiates nor oxygen were administered during the trial period. Steroids were given to patients experiencing extensive nasal polyposis and allergic fungal sinusitis post-operatively, irrespective of their group.

All included patients were admitted for > 48 hours, without intensive care measures. In patients with frequent airway negative pressure, suction was administered from the anterior opening to prevent the tube from becoming obstructed with a crust from secretions and clots at the nasopharyngeal end. Patients were monitored when asleep in the ward, especially overnight, for blood pressure and SpO2 levels. Each patient was subjected to two nocturnal oximetric (in the finger) studies, both with and without nasal packing, for comparison purposes. Oximetry without packing was taken as the baseline condition for each patient. Three readings were taken consecutively with a two hour gap overnight, beginning when the patient fell asleep; then, the average saturation was calculated. In cases of epistaxis, a baseline reading was taken after pack removal. Readings taken on the second post-operative night were taken as endpoints of the trial period to avoid any possible influence of anaesthesia on the first post-

Table 2

The frequency of symptoms in each group

Symptom	Group A (B/L Nasal Pack) N = 30	Group B (U/L airway) N = 30	Group C (B/L airway) N = 30
Nasal obstruction	30 (100%)	10 (33%)	7 (23%)
Headache	30 (100%)	15 (50%)	12 (40%)
Dry mouth	25 (83%)	10 (33%)	5 (16.6%)
Difficulty speaking	20 (66.6%)	8 (26.6%)	8 (26.6%)
Difficulty swallowing	25 (83%)	12 (40%)	12 (40%)
Difficulty sleeping	24 (80%)	10 (33%)	10 (33%)

B/L = bilateral, U/L = unilateral.

Table 3

Examination findings in each group

Examination findings	Group A (B/L Nasal pack) N = 30	Group B (U/L airway) N = 30	Group C (B/L airway) N = 30
Blood pressure (Systolic rise > 20 mmHg)	20 (66.6%)	0	0
SpO2 (decrease > 4%)	10 (33%)	0	0
Negative middle ear pressure (< -50)	5 (16.6%)	0	0

B/L = bilateral, U/L = unilateral.

operative night; the results from the second post-op night were similar to the first post-op night.

Desaturation is defined as decrease in oxygen saturation to < 95% or exceeding 4% of the preceding baseline.[3] Four percent or more was considered an alteration in saturation to avoid instrumental variations, as the accuracy of the oximeter is reported to be 2 percent.[2] Similarly, blood pressure was monitored overnight with three readings taken every two hours, starting after the patient fell asleep, and an average was calculated. Tympanometry was done in the outpatient department both pre- and post-operatively to assess the eustachian tube function. Middle ear pressure was monitored both with and without the pack in all the groups and the findings compared.

Thus, all patients were assessed for:

a. Subjective complaints: headache, nasal obstruction, rhinorrhoea, epiphora, eye redness, post nasal drip, hyposmia, sleep disturbance, dry mouth, difficulty swallowing, and speech (as shown in Table 2).
b. Objective assessment: blood pressure monitoring, SpO2 monitoring, middle ear pressure monitoring (as shown in Table 3).
c. Complications if any.

Results

As shown in Table 2, all 30 patients (100%) in Group A complained of nasal obstruction and headache, while 25 (83%) complained of dry mouth. In Group B, i.e. with the unilateral airway, only 10 (33%) patients complained of nasal obstruction and dry mouth, while 15 (50%) complained of headache. In Group C, i.e. with the bilateral airways, only 7 (23%) complained of post-operative nasal obstruction, 12 (40%) of headache, and 5 (16.6%) of dry mouth.

The number of patients in Group A complaining of difficulties in speech, swallowing, and sleep were 20 (66.6%), 25 (83%), and 24 (80%), respectively. In Groups B & C, 8 (26.6%) patients in each group complained of speech difficulty; while 12 (40%) and 10 (33%) patients complained of swallowing and sleep difficulties in Group B and C, respectively. There was no major variation in symptoms of rhinorrhoea, epiphora, eye redness, post nasal drip, and hyposmia in all the groups, as the percentages were almost comparable.

The examination findings are shown in Table 3 for comparison. Twenty (66.6%) patients in Group A showed an increase > 20 mm of

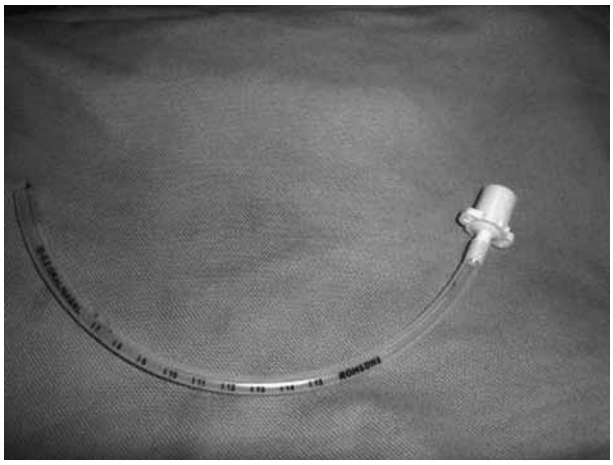

Figure 1
Poly-vinyl chloride (PVC) uncuffed, uncut endotracheal tube number 5, which was cut in two equal halves and used as a nasal airway.

Figure 2
A PVC half tube in the left nasal cavity along with bilateral anterior nasal packing.

Hg in their blood pressure; while, no patient in Groups B & C showed any change in blood pressure. Ten patients in Group A showed a >4% decrease in average SpO2 during sleep, while no change was seen in the other two groups. Five (16.6%) patients in Group A showed negative middle ear pressure ranging from minus 50 to minus 100 daPa in a single ear or bilaterally. In total, 8 ears were affected and all became normal within 24 hours of removing the nasal packs. All ears were asymptomatic and no patient had evidence of middle ear effusion. We noted no significant change in middle ear pressure in the other two groups.

Statistical analysis of the observed data was done using Chi square test and $p < 0.05$ was considered significant. The p values between the groups were found to be significant for nasal obstruction, headache, dry mouth, and difficulties in speech, swallowing, and sleep. Statistical analysis was not possible for the rise in blood pressure, decrease in SpO2, and negative middle ear pressures for patients with anterior nasal packs without airways, as there were no patients in the airway groups with these changes. There was no statistically significant differences found in the two airway groups, whether the airway was uni- or bilateral. Use of the airway itself was not responsible for any complications.

Discussion

After any nasal surgery, it is customary to place a pack in the nasal cavity to stop bleeding, enhance apposition of mucosal flaps, prevent the formation of septal haematoma, and to splint the septal cartilages and nasal bones. Complete bilateral nasal packing may cause oedema of the nose and periorbital area, excessive lacrimation, sleeplessness, dry mouth, and even cardiopulmonary complications.[1] Nose packs are not only uncomfortable, but their removal is equally painful and can cause other complications like bleeding, adhesions, septal perforations, and rarely infections.

Nasal obstruction increases both nasal and pharyngeal resistance during inspiration, particularly at the oropharyngeal level.[6] These physiological effects are manifested more during sleep than waking conditions. Similarly, obstructive sleep apnoea syndrome (OSAS), which often results from a collapsible upper airway, becomes aggravated in cases of nasal obstruction, leading to an increase in the number of apnoeas.[7] Patients with OSAS are at risk for hypoxemia, especially after general anaesthesia, which may evoke cardiac ischemia and ventricular arrhythmia.[8] We support this theory after seeing a drop >4% in the average SpO2 during sleep in 10 (33%) patients with complete nasal packing; although, we did not encounter any cases with cardiac complications.

Thus, patients with OSAS require intensive care monitoring and nasal continuous positive airway pressure to reduce apnoea and oxygen desaturations. Postoperative nasal packing makes it impossible to use nasal continuous positive airway pressure. The

available oxygen facemasks are designed for standard face and nose structures. These routine face masks do not fit properly after post-operative nasal packing with gauze bandages is applied under the nose (to reduce blood dripping); the masks often slide sideways or over eyes, causing patient discomfort. The surgical result may even be at risk if the mask is placed incorrectly or with pressure.[3] Due to these difficulties, we do not routinely give oxygen to patients at our hospital with post-operative nasal packs. The only exception being patients diagnosed with OSAS, as they are more prone to hypoxemia and its adverse cardiovascular risks.

Nasal packing is also associated with post-operative eustachian tube dysfunction and changes in middle ear pressure. The different pathogenetic possibilities are direct occlusion of the tubal orifice, inflammatory mucosal oedema, insufficient swallowing, and insufficient air current through the nasopharynx.[9] A study by Thompson, which included 63 patients with bilateral nasal packs, showed reduction of middle ear pressure in 46% of patients, of which 76% became normal within 24 hours of removing the nasal packs.[4] On the contrary, we found a decrease in middle ear pressure in only 5 (16.6%) of our patients with complete nasal packing and the pressure returned to normal in all cases (100%) within 24 hours of pack removal. The Thompson study found all ears to be asymptomatic and no evidence of middle ear effusion in any of the affected ears, which is very similar to our observation. Bonding *et al*.[10] also used tympanometry to study the effect of nasal packing on middle ear ventilation. He found unilateral anterior packing produced no significant changes in middle ear ventilation. Similarly, in our study, no change was seen in middle ear pressure in patients with airways, even when present on only one side.

Dysphagia is another common complaint. If a patient swallows when the nasal passages are blocked (Toynbee manoeuvre), air cannot pass anteriorly and is insufflated into the middle ear. This unpleasant feeling results in poor oral intake while the packing is in place.[11] Similar complaints were made by 25 (83%) of our patients with the complete nasal pack. Pulse oximetry measures peripheral arterial oxygenation based on the haemoglobin dissociation curve. This allows the oxygen desaturation index (ODI) to be determined, a value ≥ 12 indicates the existence of apnoeas-hypopnoeas.[12] Nocturnal oximetry is a safe, effective, and non-invasive method for monitoring episodes of hypoxia during sleep in patients with nasal obstruction.[13] Though, oximetry is only one method and is not as sensitive or specific as a formal polysomnogram.

In studies in dogs[14] following nasal packing, a significant decrease in arterial oxygen tension was found, which returned to normal when the packing was removed. No decrease in oxygen tension could be detected in laryngectomized dogs with nasal packs, suggesting that nasal airway obstruction with secondary hypoventilation, rather than increased bronchomotor tone (via a nasopulmonary reflex), is the underlying physiological mechanism for hypoxia in awake dogs with nasal packing. In a study by Regli *et al*.,[3] it was observed that after nasal surgery and packing, oxygen desaturation significantly increased (ODI $<90\%$) in a group without overnight oxygen compared to a group with overnight oxygen, regardless of OSAS. They suggested all patients with post-operative nasal packing should receive overnight oxygen. Special care must be taken in applying the face mask to avoid putting the surgical result at risk. They found overnight oxygenation was helpful in preventing detrimental effects from hypoxemia, like myocardial ischemia, even in patients with mild to moderate OSAS with nasal packs. Armengot *et al*.[15] recorded a significant worsening in ODI during nocturnal sleep in 92.5% of patients studied, with 47.5% of cases having pathological values. The study included both patients with epistaxis and post-operative bilateral nasal packing. They found that nasal occlusion generates desaturation episodes and even apnoea in patients with sleep disorders and healthy individuals.

Kristensen *et al*.[16] used Merocel with airway and concluded this partial nasal packing eliminates the post-operative increase in the duration of nocturnal oxygen desaturation periods, despite the small inner diameter of the airway tube and the difficulties in keeping it open. We found no episodes of oxygen desaturation in any of our patients with either unilateral or bilateral airways placed alongside the nasal packs. The number 5 endotracheal tubes provide a wide lumen that maintains the airway with less chance of blockage. Nasal packing material with an airway is commercially available; yet, it is costly with a small airway lumen and is inconvenient to

introduce because of the large width, especially following sinus surgery. Moreover, it does not apply the desired pressure over the whole septum.

As shown in Table 2, postoperatively, the frequency of nasal obstruction, headache, dry mouth and difficulty in speech, swallowing, and sleep were markedly reduced in patients with bilateral airway nasal packs, but not completely absent. Thus, the blockage of sinus openings on the lateral wall and some other factors may play a role in these complaints. Further study is needed to identify such factors. No patients with airways experienced rises in blood pressure and decreases in oxygen saturation and middle ear pressure (Table 3), which suggests the usefulness of the airway in avoiding these complications.

The groups in our study were not homogeneous for gender and age because of continuous recruitment. The use of steroids in patients with ethmoidal polyposis or allergic fungal sinusitis postoperatively, irrespective of the groups they belonged to, added further heterogeneity. Still, the results clearly highlighted the benefits of nasal airways in patients with nasal packs.

Conclusion

Bilateral complete nasal packing causes nocturnal oxygen desaturation in both healthy patients and those with OSAS. It also compromises eustachian tube function and, thus, middle ear ventilation and plays a role in temporary negative intratympanic pressure. The use of nasal packing with an airway seems to prevent these complications. A unilateral airway gave the same results as the bilateral airways. This newer concept of using an airway fabricated from an endotracheal tube and placed along the bilateral nasal packing may help to reduce postoperative morbidity and reduce the risk of hypoxemia.

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