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Impact of short-time nasal intubation on postoperative respiration*

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SUMMARY *Until now few data on postoperative nasal respiration after nasal intubation is known which is of special importance for surgery, where postoperative intermaxillary fixation is necessary. This study was planned to acquire information about nasal breathing during the first postoperative week. Twelve patients treated for mandibular retrognathism were examined repeatedly by way of anterior active rhinometry, acoustic rhinometry, and rhinoresistometry before and after surgery over one week. In addition the subjective evaluation was checked on a visual analogue scale. Following intubation, significant changes in "objective" and subjective measurements of nasal respiration could be noted only on the second postoperative day. Comparing rhinomanometric and subjective data, a correlation could be found on postoperative day two only. In this study group short-time nasal intubation had no significant impact on postoperative respiration.*

Key words: acoustic rhinometry, intermaxillary fixation, nasal respiration, nasal intubation, rhinomanometry, rhinoresistometry

INTRODUCTION

Nasal intubation is a prerequisite in surgery affecting dental occlusion since an oral airway may interfere with intermaxillary fixation (IMF) necessary to control movements of the upper and lower jaws. Concerning complications of nasal intubation, many reports dealing with iatrogenic injuries and difficulties in introducing the tube have been published but little information exists on postoperative nasal respiration (Holdgaard et al., 1993; O'Connell et al., 1996). As intermaxillary fixation may limit oral breathing free nasal respiration should be possible in the first postoperative period. This study was initiated to gain exact data on possible changes on nasal respiration measuring it with "objective methods". Here active anterior rhinomanometry and acoustic rhinometry as complementary non-invasive examinations were chosen as these are widely accepted for rhinologic studies (Clement, 1984; Cole, 1993; Roithmann et al., 1995; Roithmann et al., 1994; Sipilä et al., 1994; Warren et al., 1987).

MATERIALS AND METHODS

Patient and surgery selection

From September 1997 to September 1998, 12 patients, 9 females and 3 males aged from 21-29 yrs (average 26 yrs) who were scheduled for mandibular orthognathic surgery (bilateral sagittal split osteotomy: BSSO) because of mandibular retrognathism participated in this study. All patients were free from known allergies or vasomotor rhinitis and had neither apparent septal deviation (examined by way of rhinoscopy, acoustic rhinometry, and in part by nasal endoscopy) nor undergone any nasal surgery before. BSSO was chosen as a model surgery because adjunct maxillary surgery would have interfered with the nasal airways and in traumatologic cases concomitant nasal trauma is often found. Surgery was performed as a standard procedure via an intraoral approach (Bell et al., 1992). Internal fixation by way of titanium miniplates was used followed by at least one week of rigid intermaxillary fixation.

Nasal Intubation

Nasal intubation was performed by one senior anaesthesiologist after nasal decongestion (oxymetazoline) following the carefully widening of the nares with three soft wendel tubes in different sizes, using lidocaine jelly as a lubricant. As patients suffering from noticeably septal deviation did not participate, the site of intubation was chosen by the anaesthesiologist randomly. Then the tube (RAE nasal, tracheal preformed tube with cuff; Mallinckrodt Medical, Athlone, Ireland) was introduced and directed with a magill forceps into the trachea. The size of the tube was chosen by the anaesthesiologist ranging from # 6.5 to 8. The period of intubation lasted from 2 to 4 hours depending upon the progress of surgery. After the tube had been taken out, the nose was thoroughly sucked with a soft flexible catheter. On

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the first night and day after surgery nasal decongestants were applied one to three times if requested by the patients.

Functional assessment of respiration

Evaluation of nasal respiration was performed by way of active anterior rhinomanometry (Diagnostikcenter F, Homoth, Hamburg, Germany) using a tight fitting face mask and by fixing the pressure tube with tape to one nostril while the patient breathed through the other one and vice versa (Clement, 1984). Five constant breathing cycles were recorded to calculate inspiratory flow (ml/s) at a standard pressure of 150 Pa. For measuring the size of the nasal cavity acoustic rhinometry was utilized (Rhinoklack, ISM GmbH Wettenberg, Germany). To decrease errors due to patient movements an ophthalmologists head support was used, and ultrasound jelly was applied for an airtight seal. Acoustic scans were accepted if five shots taken during exspiratory breathholding and one after some breathing cycles did not deviate. Data acquired from acoustic rhinometry were minimal cross-section area and volume of the segments 0-2 cm, 2-4 cm, and 4-6 cm distal of the nares. In addition to this rhinoresistometry (Rhino-Resisto-Meter RRM 1000, ISM GmbH Wettenberg, Germany), a modified rhinomanometric technique was utilized to calculate the hydraulic diameter (diameter of a tube with similar flow properties) of both nares and of the total nose (Mlynski & Löw, 1993; Hierl et al., 1998). To minimize changes in airflow due to the nasal cycle the measurements were repeated after decongestion with oxymetazoline nosedrops (0.15 mg each nostril; Nasivinetten, E. Merck) after 15 minutes latency. In addition to functional assessments, all patients were clinically examined at each interval by way of anterior rhinoscopy. All functional assessments were taken by one author starting on the day before surgery and were performed always during afternoon. Subjective evaluation was performed on a 10 cm visual analogue scale before and after decongestion for the right and left nostril and regarding total nasal respiration on a scale from 0 - 10. Here, "0" means best possible respiration and 10 worst one. To study the changes on nasal respiration, follow-up measurements were carried out again on the second, fifth, and seventh day after surgery. One week of follow-up was chosen as this was the minimal period of intermaxillary fixation. Furthermore it can be argued that respiration would remain on this level even if longer intermaxillary immobilisation should be needed in case of having returned to the preoperative level by that time. Statistics included Spearman rank correlation and Wilcoxon matched pairs signed rank test calculated with the statistical program MEDAS (Medical Data Analysis; Fa. Grund, Margetshöchheim, Germany). Significance was judged at $p<0.05$. All results are expressed as the mean standard error of the mean (SEM).

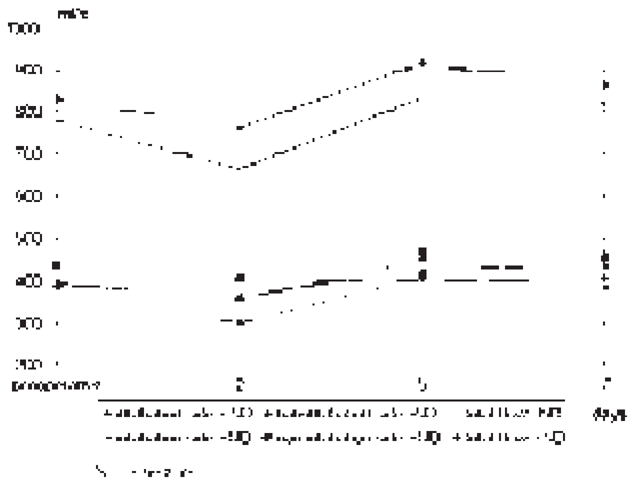

Figure 1. Inspiratory nasal airflow measured at 150 Pascal during the first postoperative week. Values for intubation and non-intubation side in addition to total nasal airflow (with and without decongestant; ND: oxymetazoline nosedrops).

Table 1. Values for subjective evaluation of nasal airflow (visual analogue scale, 0 meaning best possible status and 10 worst nasal breathing), minimal cross-section area (MCA, values in cm^2), and for hydraulic diameter (hydr. dia., data in mm). Significant increase in hydraulic diameter on the intubation side from day 2 to 7 ($p<0.02$).

		preoperative	day 2	day 5	day 7
VAS	intubation side – ND	3.2	4.6	2.9	3.1
	non-intubation side – ND	3.2	3.4	2.4	2.8
	total flow – ND	3.2	3.4	2.5	2.7
	intubation side + ND	2.3	2.6	2.2	1.2
	non-intubation side + ND	1.4	1.5	1.1	1.2
	total flow + ND	1.8	1.8	1.4	1.0
MCA	intubation side – ND	0.46	0.46	0.44	0.43
	non-intubation side – ND	0.48	0.48	0.48	0.46
	intubation side + ND	0.47	0.47	0.48	0.46
	non-intubation side+ ND	0.50	0.51	0.49	0.50
hydr. dia	intubation side – ND	4.8	3.7	4.7	4.5
	non-intubation side – ND	4.6	4.7	5.0	4.7
	total nose – ND	5.7	5.2	5.9	5.6
	intubation side + ND	5.0	4.4	5.0	4.9
	non-intubation side + ND	4.9	4.7	5.0	5.0
	total nose + ND	5.9	5.6	6.1	5.9

RESULTS

After intubation and surgery, respiratory measurements were performed on the second, fifth, and seventh postoperative day. Regarding intubation in no case a visible injury, a cracking sound or prolonged bleeding was noted. Concerning nasal inspiratory airflow, preoperative values demonstrated symmetric airflow (49% of total airflow on the intubation side, 51% on the other side) with a mean total inspiratory airflow rate of 780±49 ml/s. After decongestion an average 7% increase was found (831±50 ml/s). On the second day a decrease from the preoperative measures on the intubation side appeared, whereas no change was noted on the non-intubation side. On the fifth and seventh day preoperative values were recorded again (Figure 1). Statistical analysis (Wilcoxon test, $p>0.15$), however, did not reveal any significant differences for the whole period. The same was noted for the subjective evaluation (Table1; $p>0.14$) where a decline was seen on the second day, again without statistical significance. Minimal cross-section area and segmental analysis of nasal cavity volume did not demonstrate any significant change, either (Table 1). All these findings were seen irrespective of the use or non-use of a nasal decongestant. Concerning hydraulic diameter, the increase from day two to day five values on the intubated side proved to be significant before but not after decongestion ($p=0.02$; Wilcoxon test; increase from 3.7±0.7 to 4.5±1 mm before decongestion, Table 1). Spearman rank correlation was performed in order to test for a correlation of subjective evaluation on a visual analogue scale and to receive "objective" data. Here no significant connection could be found on days five, seven, and for the preoperative values, whereas measurements on the second day revealed a significant correlation for the intubation side regarding nasal airflow (with and without decongestant; $p<0.01$) and hydraulic diameter ($p<0.00$).

DISCUSSION

To study the impact of nasal intubation on respiration this study was performed on a small selected patient group to minimize interfering factors from surgery, preoperative diagnosis or patient history. Although a decrease in inspiratory nasal airflow and subjective assessment could be noted statistical analysis could not show overall significance. Even if values would have been of statistical significance, a decrease from total nasal airflow from 780 ml/s preoperatively to 664 ml/s on day 2 may be seen as clinically irrelevant. Comparing these findings to reports in the literature, most cases deal with rare complications like mediastinitis or turbinate displacement which might indeed limit nasal breathing (Seaman et al., 1991; Upton & Scott, 1992). O'Connell et al., (1996) reported on the incidence of minor nasal soft tissue bruising or cracking sounds in 100 patients and asked for postoperative nasal symptoms. In their study no patient reported on a change in nasal breathing. On the contrary, Holdgaard et al., (1993) saw an incidence of 11% of conchal fractures, 20% of nasal ulcerations, and 19% of bleeding among 379 patients. In a questionnaire one year after nasal intubation still 9.9% complained about decreased nasal airflow, 10.4% on bleeding, and 17% on nasal dryness. As these patients had been intubated much longer (for an average of 26 hours) their findings are, however, difficult to compare. All those patients have in common that objective data on respiration is missing as subjective evaluations may be misleading (Cole, 1993; Hardcastle et al., 1988; Sipilä et al., 1994). The situation of postoperative breathing could be different in patients with a preoperative breathing impairment, because there small changes in minimal diameter may lead to dramatically reduced airflow. It would have been interesting to measure respiration on the first postoperative day, but as the ward and equipment were not located in the same building this was rejected because of the patients' physical status at that time. Here portable devices for rhinomanometry and acoustic rhinometry would be of advantage. Findings of former studies as well as this investigation saw no correlation between tube diameter and haemorrhage or other complications (Holdgaard et al., 1993; O'Connell et al., 1996; Upton et al., 1992). Concerning nasal dilation before intubation contradicting opinions can be found. Whereas Kay et al., (1985) found a beneficial effect, Adamson et al., (1988) judged mechanical dilation as unnecessary causing haemorrhage and mucosal ulceration. In this investigation sequential dilation was performed without causing noticeable epistaxis or soft tissue bruising. Rhinomanometry and acoustic rhinometry served well as complementary methods. Rhinoresistometry is an interesting improvement of rhinomanometry furnishing information on hydraulic diameter which correlated well to airflow. Subjective evaluation and objective assessment showed no correlation except for the second postoperative day, where the biggest change from the preoperative measurements appeared. This is in accordance with the studies of Roithman et al., (1994), Sipilä et al., (1994), Hardcastle et al., (1988) , and Kim et al., (1998) who found only partial respectively no correlation, highlighting the necessity to perform exact tests. The difficulties of subjective evaluations are highlighted by the differences between ratings before and after decongestion. Here small increases in objective data went along with far superior ratings.

CONCLUSION

Data gathered during this study implies that careful short-time nasal intubation may not lead to a significant postoperative impairment of breathing which might be especially frightening for patients in intermaxillary fixation. Within a few days preoperative values were regained which would allow even a longer period of IMF. It must be added, however, that these results are limited to patients with preoperatively unimpaired respiration.

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