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Effect of endoscopic sinus surgery on antral mucociliary clearance*

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SUMMARY

Endoscopic sinus surgery (ESS) is the most used surgical approach in the treatment of chronic and recurrent maxillary rhinosinusitis. However, it still remains unclear how well surgery restores the mucociliary function in damaged maxillary sinus mucosa. There is also controversy whether to enlargen the natural ostium or not.

We examined the mucociliary clearance (MCC) of maxillary sinuses in 27 patients with chronic and recurrent rhinosinusitis. On one side only an uncinectomy was done, on the contralateral side a middle meatal antrostomy was additionally performed. The mucociliary clearance (MCC) was measured in both sides preoperatively and 9 months after the operation. Measurements of the mucociliary clearance in maxillary sinuses were done using an isotope method.

Preoperative mean residual activity on the uncinectomy side was 87.2 % and postoperative mean residual activity 94.1 %. On the middle meatal antrostomy side mean preoperative residual activity was 92.3 % and postoperative mean residual activity 88.4 %.

Residual activity was considered as good (≤50 %) on the uncinectomy side in 2 sinuses (7.4 %) preoperatively and in 1 sinus (3.7 %) postoperatively. On the middle meatal antrostomy side residual activity was considered good in 1 sinus (3.7 %) preoperatively and in 4 sinuses (14.8 %) postoperatively.

Mucociliary function remained poor even 9 months postoperatively. Surgery did not significantly improve the mucociliary function of maxillary sinus mucosa in chronic or recurrent rhinosinusitis. There was no statistical difference between operative techniques. In this study it seemed however, that uncinectomy combined with the enlargening of the natural ostium may restore maxillary sinus mucociliary clearance (MCC) better than uncinectomy alone.

Key words: chronic rhinosinusitis, endoscopic sinus surgery, middle meatal antrostomy, mucociliary clearance, uncinectomy

INTRODUCTION

Mucociliary clearance (MCC) is a major element of the defence system in the respiratory tract. Effective mucociliary function is based on a proper functional relationship between the moving cilia, mucus and periciliary fluid. In chronic rhinosinusitis, lacking of ciliated epithelia or nonfunctional cilia are regarded as the most important reasons for the impaired mucociliary clearance [(1,2)].

Endoscopic sinus surgery (ESS) is the main surgical approach for the treatment of chronic and recurrent rhinosinusitis (CRS) after failure of medical treatment. ESS is based on the theory that the maxillary sinus ostia are the most important areas in the pathogenesis of chronic and recurrent rhinosinusitis. Obstruction in the ostia is believed to lead to chronic inflammation and eventually to pathological alterations in maxillary sinus mucosa and in mucociliary clearance. Based on this theory, surgical opening of the ostia and improved ventilation of the sinuses should restore the normal mucosal function [(3,4)].

There are different opinions conserning the extent of surgery in the ostiomeatal complex. It is considered, that uncinectomy alone would be enough to restore the ventilation into the maxillary sinus, and that enlargening the ostium would interfere the normal function of the maxillary sinus [(3)].

Mucociliary function can be examined by measuring the ciliary beat frequency, the mucociliary transport rate or the mucociliary clearance. In the mucociliary clearance measurement the decrease of the radioactivity of the tracer (^{99}m-Techenetium-labeled human serum) per unit is measured from a certain

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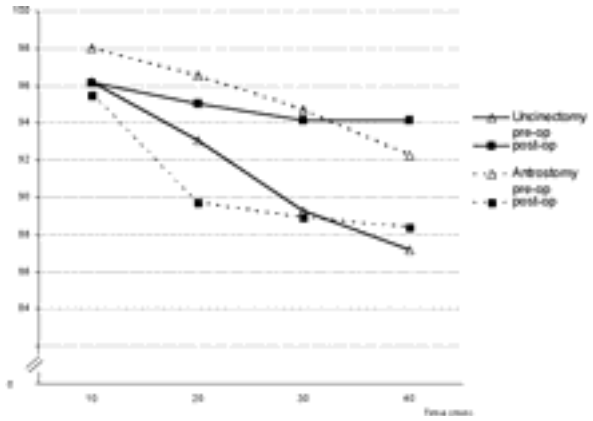

Figure 1. Mean residual mucociliary activity preoperatively and postoperatively in uncinectomy alone (n=27) and in uncinectomy combined with the enlargening of the ostium (antrostomy, n=27).

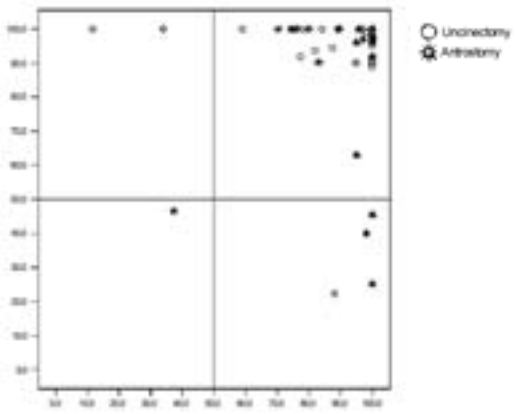

Figure 2. Residual mucociliary activity in the maxillary sinuses (n=54) preoperatively and postoperatively. Lower left quadrant indicating good mucociliary clearance in the maxillary sinus both preoperatively and postoperatively, lower right quadrant indicating restored mucociliary clerance after ESS. Upper left quadrant indicates worsened mucociliary clearance after ESS and upper right quadrant indicates poor mucociliary clearance both preoperatively and postoperatively.

area. The results are reported in percentages or in minutes needed for halving of radioactivity (T1/2).

There are studies, which involve the examination of the mucociliary clearance in chronic or recurrent rhinosinusitis [5,6]. It has been shown that the maxillary sinus mucosa recovers slowly after surgery and that there are still pathological histological findings in the sinus mucosa even 6 months postoperatively [7,8]. It has been also stated that in most cases the mucociliary clearence improves only slightly after surgery [5]. There have not been studies comparing uncinectomy and middle meatal antrostomy and the effectiveness of these operative techniques in the mucociliary clearance of the maxillary sinus. The purpose of this study was to determine the functional recovery of the maxillary sinus mucosa after ESS and to examine the possible difference between two operative techniques.

METHODS

Patients

This study was carried out at the Department of Otorhinolaryngology, Tampere University Hospital, Finland and Mikkeli Central Hospital, Mikkeli, Finland. The Committee of Ethics approved the study, and all subjects gave their informed consent. The study group comprised of 30 patients, 20 women and 10 men, age range 22 to 66 years with a mean of 47 years. In 27 patients we were able to measure the maxillary sinus mucociliary clearance (MCC) both preoperatively and postoperatively.

Diagnosis

Patients suffered from chronic or recurrent maxillary rhinosinusitis. Chronic maxillary sinusitis was diagnosed by the presence of sinus related symptoms for at least 12 weeks despite maximal medical treatment, associated with abnormalities of mucosal thickening or sinus opacification on computed tomography scan. A nasal endoscopy was performed and patients with visible polyposis in the middle meatal area were excluded from the study. There was no difference in the symptoms between sides. In preoperative CT-scan both sides had similar, moderate findings. None of the patients had aspirin intolerance, gross immunodeficiency, chronic bronchitis or cystic fibrosis. Patients with polyposis or previous sinus surgery were excluded from the study group.

Surgery

The study group underwent endoscopic sinus surgery in local anesthesia. Uncinectomy alone was done on the other side; on contralateral side a middle meatal antrostomy was additionally performed. Anterior ethmoidectomy was done, if it was considered necessary. The light middle meatal tamponation was removed on the first postoperative day. Nasal endoscopy was performed and operation field cleaned 2 weeks after surgery. Follow-up was done at 9 months after the surgery.

Measurements

MCC measurements were taken preoperatively and 9 months after the operation. Irrigation tubes (Sinoject, Atos, Hörby) were introduced through the inferior meatus into the maxillary sinuses at least 30 minutes before the measurement to avoid any reflectory ciliostasis due to puncture. The procedure was done under local anesthesia, with 4 % lidocain adrenaline cotton administered in the inferior meatus for 10 minutes. With a thin catether and 1 ml syringe, a drop (0.03-ml) of sterile human serum albumin labeled with ^{99}mTc (Venticol, Sorin Biomedica, Saluggia) was applied through the irrigation tube into the bottom of both maxillary sinuses at the the same time. Each patient was seated in front of a gamma camera (Picker SX-300, Elscint 409 ECT, Siemens Ecam) with an all-purpose parallel-hole collimator (high-resolution in Siemens) connect-

ed with a Gamma-11, Elscint or Siemens computer system for processing. Clearance of the tracer in both sinuses was monitored at the same time from an anterior view for 40 minutes. Area of the initial tracer in the sinuses was marked and clearance of tracer from the sinuses, as well as the possible appearance of activity in the pharynx, was measured with gamma imaging at time-points 0, 10, 20, 30 and 40 minutes from the anterior view, with residual activity (percentage from the initial) determined in the sinuses. Two cobalt buttons were fixed on the forehead and one on the upper part of the sternum for control of errors caused by patients` movements. Radiation activity of the amount of tracer used for both sides totalled 40 μCi; the dose of radiation for each patient was 50 μSv.

RESULTS

Preoperative mucociliary clearance

The mean residual activity on the uncinectomy side after 40 minutes in 27 sinuses was 87.2 %. On the middle meatal antrostomy the mean residual activity after 40 minutes was 94.2 %.

Preoperatively there were 13 (48.1 %) sinuses on the uncinectomy side and 15 (55.5 %) sinuses on the middle meatal antrostomy side where no clearance was seen during 40 minutes follow-up time. Residual activity was considered as good (< 50 %) in 2 (7.4 %) sinuses on the uncinectomy side and in 1 (3.7 %) sinus on the middle meatal antrostomy side.

Postoperative mucociliary clearance

The mean residual activity on the uncinectomy side after 40 minutes was 94.1 %. On the middle meatal antrostomy side the mean residual activity was 88.4 %.

Postoperatively there were 14 (51.9 %) sinuses on the uncinectomy side and 14 (51.9 %) sinuses on the middle meatal antrostomy side where no clearance was seen during 40 minutes follow-up. Residual clearance was concidered good (< 50 %) in 1 (3.7 %) sinus on the uncinectomy side (not the same sinus as in preoperative measurements). On the middle meatal antrostomy side residual clearance was considered good in 4 (14.8 %) sinuses (1 same sinus as in preoperative measurements).

DISCUSSION

Reviews of the results of endoscopic sinus surgery have reported excellent subjective results with overall improvements of about 90 % in both short and long term [9,10]. However studies have demonstrated that symptom improvement does not correlate well to objective endoscopic evidence of disease persistence [13,14].

Previous studies have shown that patients undergoing sinus surgery had histological changes, such as damage and metaplasia of the sinus mucosa, as well as ciliary changes preoperatively. The sinus mucosa seemed to recover histologically slowly and there were still remaining pathological findings, with some signs of recovery, even 6 months postoperatively [5,11].

It has been shown that the mucociliary clearance (MCC) correlates well with the histology and the histological changes of the maxillary sinus mucosa [11]. In chronic rhinosinusitis a very slow and sometimes absent mucociliary transport has been found indicating histological damage in maxillary sinus mucosa [5,12].

Measurements of the mucociliary transport in the nasal cavity after ESS have shown that after 3 months the mucociliary activity was better than preoperatively but still significantly impaired compared to healthy controls [16].

Restoration of mucociliary clearance in the maxillary sinuses is believed to be essential to the success of ESS. This study supports previous findings about poor recovery of the mucociliary function after ESS in chronic and recurrent maxillary rhinosinusitis [5,6]. Despite the fact, that histological changes in maxillary sinuses do not seem to disappear even 6 months postoperatively, a large number of patients consider themselves recovered. Diminution of the symptoms has been explained by better postoperative sinus ventilation [15,17]. Normal ventilation has probably an anti-inflammatory effect diminishing the inflammation somewhat irrespective of mucociliary clearance effects.

Although about 90 % of the patients have been reported to benefit from sinus surgery [10], ESS does not seem to effect significantly to the mucociliary function of the maxillary sinus mucosa. In our study uncinectomy alone seemed to impaire mucociliary function and uncinectomy combined with middle meatal antrostomy seemed to improve MCC only slightly during 9 months of follow-up.

The change in postoperative mucociliary clearance values was independent of the operation technique. Thus, according to our results, we are not able to say which operative technique is more effective when considering the mucociliary clearance results. However, further studies are required to find out if there are differencies between the two operative techniques when observing other subjective and objective findings.

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