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Prospective randomized investigation for evaluation of postoperative changes in the microbial climate of paranasal mucosa by the use of different dissoluting techniques during postoperative care*

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SUMMARY

Endonasal dissolution by the use of NaCl-solution is a common postoperative treatment of the nasal mucosa after endonasal surgery. These procedure involve for example endonasal shower and sterilized solutions. The contamination of nasal shower in case of unprofessional cleaning after treatment was an argument against this technique in earlier discussions. The danger of such an infection should be avoided by the use of sterilized solution. Therefore the dependence of nasal microbial climate on different nasal dissoluting techniques was investigated by the use of such named endonasal shower (Siemens und Co, Bad Ems, Germany) in comparison with sterilized solution (Rhinomer®, Zyma SA, Nyon, France). Microbial cultures were investigated of 80 patients after endonasal surgery (53 m, 27 f ; 31±21 age). Surgery was done for the treatment of chronic polypous sinusitis. Pre-, intra- and postoperative samples were taken in 640 cases to proceed microbial cultures. Material was transferred with the use of a Port-A-Cul-transport medium and preparation of the microbial cultures was done during the first four hours. As a result 895 bacterial clones were cultivated. These consisted of 87% aerob and 13% anaerob bacteria. Staphylococcus aureus (39%) and members of the family of Enterobacteriacae (30%) were the most common microbes. There was neither an evidence for postoperative microbes on the nasal mucosa nor a correlation between the dissoluting technique and the postoperative outcome. The use of sterilized solutions for the postoperative care of endonasal mucosa does not cause an additional worthful effect on neither the postoperative microbial climate nor the outcome in comparison to endonasal shower.

Key words: endonasal microbials, rhinomer, endonasal shower, endonasal surgery

INTRODUCTION

The outcome of endonasal surgery does not only depend continuously on advanced technical equipment but largely also on postoperative procedures (Hilka et al., 1992; Kennedy, 1985). Wound crusts play an important role in the reepithelisation of paranasal sinuses because of their tendency to decrease nasal ventilation and to be a really good base of infection (Kühnel et al., 1996). Removal of the highly viscous secretion from the nasal mucosa is usually done in an endoscopic suction procedure and /or by dissolution with sodium-solutions in the paranasal system. For the procedure some patients inhale the solution from their palm. This involves the risk of increased numbers of *Enterobacteriacae* on the nasal mucosa due to dermal contamination (Johannssen et al., 1996). The influence of these microbes on the endonasal system is not completely understood but it seems to inhibit the wound healing (Hosemann et al., 1991).

Nasal showers (for example Siemens & Co) could be shown to decrease the number of *Enterobacteriacae* in the postoperative care of nasal mucosa after endonasal surgery (Johannssen et al., 1996). Microbes such as *Staphylococcus aureus*, however, are not influenced by the use of this procedure. Contamination of the shower bottle cannot be avoided completely, for example, due to unprofessional cleaning after the dissolution procedure. This contamination could be avoided if sterilized solutions (for example Rhinomer®) were used. Therefore, the aim of our study was to investigate the influence of sterilized and non-sterilized

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solutions on the mircobial flora of nasal mucosa in postoperative endonasal care .

MATERIAL AND METHODS

The investigation was performed on 80 patients [53 m, 27 f (median age 31±21yrs)] who were operated between May 1996 and April 1997 at the department of Otorhinolaryngology, Head and Neck Surgery, University of Kiel. Patients had suffered from bilateral chronic polypous sinusitis for more than 6 months and did not get antibiotics more the 3 weeks preoperatively.

One or more of following symptoms were detected: nasal blockage, recurrent frontal headache and anterior/ posterior rhinorrhea.

Nasal polyps were detected by the use of microscopes and endoscopes. The CT-scan of the paranasal sinuses of these patients has been shown partially or totally opacified maxillary and ethmoidal sinuses. Endonasal ethmoidal and maxillary surgery were performed in all patients on both sides. To pack the ethmoid, $^1/_2$ inch dry gauze was inserted so as a rubber coated swab into the middle meatus or between the inferior turbinate and nasal septum, respectively. Packing was removed from the inferior part, beginning on the second day and gauze was removed on the third. Antibiotic treatment using cotrimoxazol lasted 7 days starting from the operation. Medical therapy was accomplished with decreasing systemic cortison administration, the initial dose was 50mg/d. Postoperative care of nasal mucosa consisted of endoscopic controlled wound cleaning. This procedure was supplemented by a topical application of nasal drops (dexamethasone 2mg, otriven 0,1% 10ml, lanolinum 7g, paraffinum subliquid 13g) six times a day, beconase-aquosum-spray for three weeks and two inhalations with sodium-solution daily. All patients gave informed consent after careful information. The ethics Committee of the University of Kiel had agreed to the study.

The groups of patients were chosen by a randomized procedure. First group consisted of 40 patients, who used postoperative isotone sodium solution for nasal shower applied by a shower bottle (Siemens und Co, Bad Ems, Germany). Group II (40 patients) used sterile isotone solution applied by special bottles (Rhinomer® Force 3, Zyma SA, Nyon, France).

Pre-, intra- and postoperative material from the nasal mucosa layer was taken using sterile swabs and microbial cultures were performed.

Preoperative samples originated from the right and the left middle meatus. The intraoperative material was saved from the anterior ethmoid of both sides. Further samples were collected from the anterior ethmoid 6 or 7 days and 12 to 14 weeks postoperatively. No additional antibiotics other than the ones mentioned above were administered.

The swabs were transferred to the microbiological Lab in a Port-A-Cul transport medium (Becton Dickinson, Heidelberg, Germany) and cultiviation was started no later than 4 hours after surgery . The isolation of aerobic and facultative aerobic microbes was done using sheep blood agar, Chineseblue-lactose agar and mannit-sodiumagar at a temperature of 37°C.

Anaerobe microbes were cultivated on Heimb- (Columbia-Basis-Agar) and Schädler plates (Tryptic Casein-Soja 10g/l, Pepton 5g/l, Glucose 5g/l, Hefe-Extrakt 5g/l, TRIS-Buffer 3g/l, Hemin 0,01g/l, L-Cystein 0,4g/l, Agar 13,5g/l) under anaerobic conditions. The swabs were placed in beef broth to increase the number of microbes. The transfection of cultivation plates was performed after opacification of the broth (after 48 hours). Standard methods (detection of biochemical responses) were used to identify the microbes. Statistical analysis was done by means of the x^2-test.

RESULTS

A total of 640 samples was collected from 80 patients. From these, 895 bacterial clones were cultivated and detected. More than one bacterial species was found in 54% of these cases. A comparison of the results from the right and left side did not show any significant difference ($p<0.05$). Both sides showed the same results in 79% of the cases. Physiological bacterial flora had been grown in 71%. A sterile result was found in 1% of the cases.

The result of the preoperative samples taken on the day of the patients' admission showed 87% aerobes and 13% anaerobes (Table 1). *Staphylococcus aureus* was the dominating microbe with 39% followed by the family of *Enterobacteriacae* with 30%. Penicillinase-containing *Staphylococcus aureus* cultures were detected in 79% of the *Staphylococcus aureus* species. *Staphylococcus aureus pneumoniae, Pseudomonas aeruginosa* and *Haemophilus influenza* could be found only in some cases (0-8%). In the group of aneaerobes, *Peptococcus* was the dominating microbe with 9% followed by *Bacteroides* cultures.

The results of the second set of samples collected intraoperatively showed members of the *Enterobacteriacae* in 33% and *Staphylococcus aureus* in 32% of the cultivated microbes. The distribution of microbial species in the third part of investigation on the 7th postoperative day was similar to the first. There was no remarkable difference between the different procedures of nasal dissolution. *Staphylococcus aureus* and *Enterobacteriacae* dominated the microbial cultures.

The fourth step of investigation, 12 to 14 weeks postoperative did not show a significant difference ($p<0.05$) between the two groups (nasal shower bottle/ sterilized solution rhinomer bottle). *Staphylococcus aureus* was the most common microbe in both randomized groups with 40% and 41%, respectively. Members of the family of *Enterobacteriacae* were isolated in 22% and 21% of the cases, which is less often than in the first step of the investigation (30%). Sterile culture plates were found in neither group.

Epithelial regeneration during wound healing thus was not significantly influenced by different nasal shower procedures

DISCUSSION

Endonasal surgery is a functional procedure to save nasal mucosa, but postoperative lesion is characterized by mucosal defects

Table 1. Distribution of the isolated microbes in percent.

A: Aerobier

Microbe	**1. Sample (Attending)**	**2. Sample (intraop.)**	**3. Sample (7 days post.) Shower/Rhinom.**	**4. Sample (3 months post.) Shower/Rhinom.**
Staph. aureus	39%	32%	35%/32%	40%/41%
Therefrom *Penic.-pr.*	79%	60%	68%/61%	61%/63%
Haemolys. Streptoc.	6%	4%	0%/4%	0%/6%
Streptoc. pneumon.	0%	0%	4%/0%	6%/4%
Pseudom. aerug.	4%	8%	6%/4%	8%/6%
Hämophil. influ.	8%	4%	4%/6%	0%/4%
Enterobacteriacae	30%	33%	29%/32%	22%/21%
Aerobier over all	**87%**	**81%**	**78%/78%**	**76%/82%**

B: Anaerobier

Microbe	**1. Sample (Attending)**	**2. Sample (intraop.)**	**3. Sample (7 days post.) Shower/Rhinom.**	**4. Sample (3 months post.) Shower/Rhinom.**
Bacteroides sp.	4%	8%	7%/10%	8%/9%
Peptococcus	9%	11%	15%/12%	16%/9%
Aerobier over all	**13%**	**19%**	**22%/22%**	**24%/18%**

and exposed endonasal bone. Regeneration of the nasal mucosa was investigated by Hosemann et al., (1991) who found the four following steps in wound healing: bloody crusts in the operation field (to ten days), lymphoedema (up to 30 days), mesenchymal regeneration (to three months) and scare formation (after three months). Infections are able to inhibit the wound healing and may lead to decreased regeneration during this period (Hosemann et al., 1991).

Crusts play an important role in this process. They are involved in the physiological wound healing, but depending on localisation and size, decreased nasal ventilation may be caused by crusts. The disturbed drainage of paranasal sinuses supports inflammation (Kühnel et al., 1996). Furthermore, the crusts are able to inhibit the mucociliary clearance. This may lead to a decreased self cleaning mechanism in the nose with an increase of crusts (Keerl et al., 1997; Mann, 1982). Endonasal shower is a possibility of stopping such a process by dissolution of the paranasal sinuses with salt-solutions. This procedure leads to a nearly atraumatic dissolution of endonasal crusts and the secretions are removed from the nasal mucosa (Michel et al., 1991; Weber et al., 1996). The result of such postoperative care could be influenced by modifications of the shower technique or the contents of shower solutions. The equipment which is needed for the procedure are nasal shower bottles (Siemens und Co, Bad Ems, Germany), irrigators or the palm of the hand (Keerl et al., 1997).

Earlier investigations showed that contamination of the endonasal mucosa by *Enterobacteriacae* could be decreased from 38% when the hand was used to 13% when nasal shower bottles were used. Dermal contamination of the dissolution seems to support the growth of some microbes on the endonasal wound surface (Johannssen et al., 1996). The results of the first two steps in this study underline the result of our earlier study about microbes after endonasal surgery. *Staphylococcus aureus* and members of the family of *Enterobacteriacae* could be detected in most cases and seem to play an important role in chronic polypous sinusitis. Doyle and coworkers (Doyle et al., 1991) found *Staphylococcus aureus* (32%) and *Enterobacteriacae* (15%) as the dominating microbes in patients who suffered from chronic ethmoidal sinusitis. Kessler (Kessler, 1967), Krajina (Krajina et al.,1969) and Simoncelli (Simoncelli et al., 1992) detected *Staphylococcus aureus* in chronically inflamed maxillary sinuses significantly less frequent (8-12%). The incidence of penicillinase-producing *Staphylococcus aureus* (66%) in the literature does not differ signifcantly from the results in this study (Rosin, 1989). *Streptococcus pneumoniae* and *Haemophilus influenza* could be cultivated rarely (0-8%). Whereas Mann (1982) and Doyle et al., (1991) report the same incidence, Karma (1979) and Simoncelli (Simoncelli et al., 1992) detected these microbes much more often (20-30%).

The use of nasal shower bottles prevents dermal contact with the shower solution. A contamination of the shower bottles cannot be excluded completely because of uncareful cleaning of the bottles after the procedure. Therefore, bacterial growth is possible in the bottle which influences endonasal bacterial growth in the operated paranasal sinuses. Contamination of the bottles can be avoided by using sterilized solutions in sterilized closed bottles. The effect of such a modification is shown by the third and fourth step of this study. The outcome of patients and the endonasal microbial growth are nearly the same in patients

who used the nasal shower bottle (Siemens & Co.) and those who used sterilized solutions and bottles (Rhinomer®). *Staphylococcus aureus* was the dominating microbe (40% and 41%) in both groups, followed by the members of the family of *Enterobacteriacae* (22% and 21%). Therefore, contamination of the nasal shower bottles does not seem to happen because of very carefully cleaning by the patients or it does not influence endonasal bacterial growth.

Seppey et al., (1996) and Krayenbuhl and Seppey (1995) reported about a positive effect of postoperative endonasal care with Rhinomer® on the outcome of patients after endonasal surgery. This prospective, randomized study could not detect any significant difference between different techniques of postoperative nasal shower. Special techniques for the documentation of the mucosal dynamic (computer based Morphens, quick-motion films) were not used in any of these studies.

In conclusion, the results of this investigation suggest that the use of sterilized solutions and sterilized bottles (Rhinomer®) in the postoperative endonasal care of the mucosa does not lead to any advantage in comparison to the use of nasal shower bottles (Siemens & Co.) when bacterial growth and outcome for patients after endonasal surgery is regarded. The cultivated microbial cultures are nearly identical in both procedures. Furthermore, no difference was detected in the wound healing of these two methods. Regarding the cost-benefit ratio the use of nasal shower bottles and cleaning by the patients seems to be an adequate and effective supplement in the postoperative care after endonasal surgery. The use of sterilized bottles Rhinomer® is much more comfortable, but expensive in comparison to shower bottles, so that the patient should decide which procedure is preferable.

REFERENCES

1. Doyle PW, Woodham JD (1991) Evaluation of the microbiology of chronic ethmoid sinusitis. J Clin Microb 29: 2396-2400.
2. Hilka B, Koch T, Laszig R (1992) Spätergebnisse nach endonasaler Siebbeinoperation unter besonderer Berücksichtigung der polypösen Sinusitis. HNO 40: 165-169.
3. Hosemann W, Dunker I, Göde U, Wigand ME (1991) Experimentelle Untersuchungen zur Wundheilung in der Nasennebenhöhle. HNO 39: 111-115.
4. Johannssen V, Maune St, Erichsen H, Hedderich H, Werner JA (1996) Der Einflufl der postoperativen endonasalen Schleimhautpflege auf die nasale Bakterienflora: Untersuchung zweier Spülverfahren mit NaCl-Lösung nach Nebenhöhlenchirurgie. Laryngo Rhino Otol 75: 580-583.
5. Karma P (1979) Bacteria in chronic maxillary sinusitis. Arch Otolaryngol 105: 386-390.
6. Keerl R, Weber R, Müller Chr, Schick B (1997) Zur Effizienz und Verträglichkeit der Nasenspülung nach endonasaler Nasennebenhöhlenoperation. Laryngo Rhino Otol 76: 137-141.
7. Kennedy W (1985) Functional endoscopic sinus surgery. Arch Otolaryngol 111: 643-649.
8. Kessler L (1967) Die Bakterienflora der Nasenhaupt - und Nasennebenhöhlen bei chronischen Sinusitiden und ihre Beziehung zueinander. HNO 16: 35-39.
9. Krajina Z, Koskovic F, Babic L (1969) The bacteriology of the respiratory tract in various pathological conditions. Acta Otolaryngol 67: 453-459.
10. Krayenbuhl PM, Seppey M (1995) Efficacite de Rhinomer force 3 dans les suites operatoires de la chirurgie endonasale. Revue Medicale de la Suisse Romande 115: 249-252.
11. Kühnel Th, Hosemann W, Wagner W, Fayad K (1996) Wie traumatisierend ist die mechanische Schleimhautpflege nach Eingriffen an den Nebenhöhlen? Laryngo Rhino Otol 75: 575-579.
12. Mann W (1982) Diagnostik entzündlicher Nasennebenhöhlenerkrankungen. Arch Otorhinolaryngol 235: 41-67.
13. Messerklinger W (1987) Die Rolle der lateralen Nasenwand in der Pathogenese, Diagnose und Therapie der rezedivierenden und chronischen Rhinosinusitis. Laryngo Rhino Otol 66: 293-299.
14. Michel O, Charon J (1991) Postoperative Inhalationsbehandlung nach Nasennebenhöhleneingriffen. HNO 39: 433-438.
15. Rosin H (1989) b-Lactam-Antibiotika. Internist 30: 2-12.
16. Seppey M, Schweri T, Häusler R (1996) Comparative randomised clinical study of tolerability and efficacy of Rhinomer force 3 versus a reference product in post-operative care of the nasal fossae after endonasal surgery. Otorhinolaryngol 58: 87-92.
17. Simoncelli C, Ricci G, Molini E, Garell C, Capolunghi B, Giometti S (1992) Zur Bakteriologie der chronischen Sinusitis maxillaris. HNO 40: 16-18.
18. Weber R, Keerl R, Huppmann A, Schick B, Draf W (1996) Der Einflufl der Nachbehandlung auf die Wundheilung nach endonasaler Nasennebenhöhlenoperation. Laryngo Rhino Otol 75: 208-214.

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